2002 Annual Report

Crop Diversification Centre South
Crop Diversification Centre North

Alberta
AGRICULTURE, FOOD AND
RURAL DEVELOPMENT

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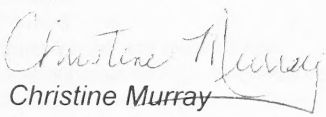
Introduction

C.L. Murray, Branch Head

The Crop Diversification Centre South (CDCS) is one of the research and development units of the Crop Diversification Division of Alberta Agriculture, Food and Rural Development (AAFRD). The CDCS focus is on applied research and technology transfer in support of horticulture, special crop, forage seed and agronomy in Alberta. The Centre's mandate of crop diversification and industry development is achieved through close partnerships with commodity organizations, grower groups, agribusinesses, university, federal and private sector researchers, agricultural colleges, and individual producers and processors.

Programs specialize in research to support sustainable growth of crop industries such as: potatoes, fruit and vegetables, greenhouse crops, nursery crops, grass and forage seeds, special crops and field crops. The plant pathology program leads research in support of many of the crop industries. CDCS provides full administrative and farm/shop support for programs at the Brooks headquarters location.

This annual report covers the activities of CDCS research staff at Brooks and Lethbridge and technology transfer staff at Lethbridge, Oyen and Taber. Only brief summaries of projects and trials carried out in 2002 are reported here. Please refer to the *Publications and Presentations* section of this report for sources of more detailed information.



Christine Murray
Branch Head

Branch Head Report

C.L. Murray, Branch Head

In 2002 the Industry Development Sector of Alberta Agriculture Food and Rural Development underwent a complete restructuring. Six new Divisions were created: Crop Diversification, Livestock Industry, Ag-Entrepreneurship, Business and Innovation, Processing Development and Agri-Food Investment. As well a Program Information Services group was developed that includes the Ag-Info Centre, Strategic Direction and Measures, Strategic Change and Research Direction chairs. Five Key Growth Initiatives are being pursued by IDS staff to growth the agricultural industry in Alberta to meet the goal of $20 billion value-added and $10 billion in primary production by 2010. Crop Diversification Staff will work on these key initiatives in various ways using their knowledge, background and research ability. The initiatives are focussed on the growth in: functional foods and nutraceuticals, pork production, processed meats and meals, beef production, non-food and industrial uses.

The Crop Diversification Centre South also had many changes in programs and staff as a result of the restructuring. A number of staff retired or left CDCS. Their contribution over their many years of service is appreciated.

New and different program responsibilities were taken on by:

- Dr. Chris Neeser now leads the combined fruit and vegetable program assisted by technologist Thean Pheh, who transferred from CDCN.
- Shelley Woods became the leader of the soil and water agronomy program and assisted by technologist Leonard Hingley.
- Dr. Ross McKenzie and his technologists, Allan Middleton, Kevin Seward, Pat Pfiffner and Chad Poulsen, joined CDCS from the former agronomy unit.
- Lori Delanoy, Taber, is the Provincial Potato Specialist with some responsibilities in other irrigated vegetables.
- Rob Dunn, Lethbridge, Integrated Crop Management Specialist, Southern Alberta Cropping Systems joined CDCS from the former Southern Region.
- Trevor Wallace, Oyen, Integrated Crop Management Specialist, Feed & Fodder Production joined CDCS from the former Southern Region.
- Dr. Ron Howard, is again a full time Plant Pathologist assisted by technologist Sharon Lisowski.
- Simone Dalpe has joined the potato program as a technologist.
- Andrew Fox has joined CDCS as the special crops technologist.
- Dr. Kan-Fa Chang transferred to the Field Crop Development Centre in Lacombe to lead the Plant Pathology Program that will support the new Pea Breeding Program at AAFC - Lacombe

CDCS staff continued to work closely with other AAFRD staff, colleagues from universities, agricultural colleges, other federal and provincial research organizations, and a wide variety of industry groups. They organized and participated in numerous information sessions, workshops, field days, scientific conferences and tours in 2002.

This Annual Report is a summary of ongoing research and extension programs. It represents the dedicated work of CDCS staff who play a major role in the development of the agriculture and agri-food industry in Alberta. Additional information on any program area, including detailed research reports, is available upon request.

Agronomy Program

R. McKenzie,A. Middleton, P. Piffner, C. Poulsen

Research Projects

Mustard Project
2002 was the final year of mustard production field research trials. A final report was completed. Results have been shared with the Extension Agronomists for technology transfer. Fact sheets on mustard nutrient requirements and agronomic recommendations are in the process of being written.

Chickpea Project
2002 was the third year of chickpea production field research trials. A complete report of the trial has been written and program leader is working with the Extension Agronomists for technology transfer.

Triticale Project
A team was assembled to develop a triticale production research and marketing proposal for Alberta. An inter-agency team was assembled to develop and submit proposals to pursue funding to conduct triticale production research, market evaluation and market development. Triticale research proposals were submitted to NIF, WGRF and ACIDF; all proposals were rejected.

Long-term crop rotations in Brown soil zone
This trial evaluates the long-term effects of six different crop rotations on soil quality and economic viability. Results of the effects of crop rotations on soil quality changes were published in the Can. J. Soil Sci. A report was completed on the economic viability of different crop rotations in the Brown soil zone with the University of Lethbridge. A paper on the short-term impact of fallow frequency and perennial grass on soil organic carbon in a Brown Chernozemic soil in southern Alberta was published.

Optimizing wheat and yield and protein project
The data were compiled and a final report was completed for the AARI project. Results were also published in the Can. J. Ag. Econ.–Smith, McKenzie and Grant. 2003. Optimal input use when inputs affect price and yield.

New Agricultural Product Development
Studies were conducted in conjunction with industry to develop and evaluate new products to enhance crop production. This was a joint venture with Agrium evaluating new slow release N fertilizers to optimize crop yield; Cargill developing new effective phosphorus-sulphur fertilizer compounds; Symbio Ag evaluating rapid release phosphate fertilizer and Syngenta evaluating new protective seed treatments for pulse crops. Results were compiled for the testing of each company.

Technology Transfer

Program Leader, R. McKenzie acted as catalyst for CDCS. The catalyst encourages and stimulates interaction of staff. The catalyst interacted with the branch leader, work with program leaders and extension agronomists to explore new multi-disciplinary research projects and develop technology transfer plans with other division and sector staff.

Fruit and Vegetable Research Program

C. Neeser and T. Pheh

Research Projects

Agronomic practices for vegetables

Use of calcium chloride foliar sprays on field grown vegetable crops

Current research in human nutrition suggests the typical diet is deficient in calcium. Therefore, consumption of calcium-enriched vegetables could have a significant health benefit. The production of vegetables with exceptional high levels of calcium presents an opportunity to add value to locally grown produce.

The objective of this study was twofold: 1) To determine whether foliar applications of calcium chloride will result in higher levels of calcium in the edible portion of cucumber, romaine lettuce, carrot, and broccoli. 2) To measure whether calcium treatments would decrease moisture loss in storage.

Treatments consisted of 0 to 6 foliar applications of a 1% calcium chloride solution. Data analysis is pending. Preliminary analysis indicated the greatest increase in calcium levels occurred in romaine lettuce; there was no increase in broccoli and cucumbers. Significant treatment effects were also found with respect to water loss in storage. Surprisingly however, these effects did not follow any obvious trend with respect to application frequency. Additional studies will be conducted to further clarify this issue.

Comparison of drip and sprinkler irrigation in vegetable production

Water is often a limiting factor for vegetable production in Alberta. Drip irrigation systems are well established in other vegetable production areas, but are not yet widely adopted here. There are advantages and disadvantages to drip irrigation, which require careful consideration. The purpose of this study is to compare the performance of a sprinkler and a drip irrigation system for vegetable production.

In 2002 results generated from this experiment were inconclusive due to the unusual high amount of rainfall. This experiment will be repeated in 2003. The data generated is expected to provide answers to questions on water requirements, influence on crop yield and other management costs associated with each of the irrigation systems.

Partial funding for this project was provided through the Alberta Market Gardeners Association.

Use of green manure for production of organic sweet corn

Sweet corn requires high soil nitrogen levels to produce optimal yields. In organic systems the supply of nitrogen is the most important production constraint. Certified organic livestock manure is often not available or too expensive. The most economical method of supplying the required nitrogen is often through the use of green manures. With proper management, legume crops used as green manures can supply sufficient nitrogen for sweet corn.

The major drawback of a green manure crop is no direct revenue is generated. In order to mitigate this problem an early season crop, such as spinach, radish, or lettuce, could be planted, followed by a green manure crop in late June to early July.

The objective of this study was to identify green manure crops with a high potential to supply nitrogen when planted late in the season. Crops tested were; lentils, peas, faba beans, fenugreek, and peas. The crops were planted in July 23 and disked under on October 24. The resulting soil nitrogen levels will be evaluated in early May of 2003. This project is a first step towards the development of a regionally adapted production system for organic sweet corn.

Onions intercropped with barley: timing of removal

Onions are best produced on lighter soils, which are subject to erosion. Erosion problems can be quite severe as onions have a sparse canopy that doesn't provide much wind shelter. The possibility of intercropping onions with barley to provide protection from strong winds was evaluated. Barley was planted immediately after the onions. Ttreatments consisted of cutting the barley at boot stage and complete removal by incorporating it into the soil (rotovator).

Results indicate that either would result in a significant yield reduction. Merely cutting the barely at the boot stage triggered vigorous regrowth, resulting in 72% yield loss in the onions. Mechanically incorporating the barley into the soil was less injurious to the onions, but still reduced yield by 30%. Barley is too competitive to be intercropped with onions.

The influence of supplemental sulphur fertilizer on allicin content in garlic

Allicin is the compound credited for health benefits associated with garlic oil. It is desirable to produce garlic with consistently high levels of allicin. Allicin and its break down products are sulphur compounds that contain methyl and propyl groups. It has been suggested that high levels of sulphur in the soil may lead to increased allicin. Results from a study with onions, support this idea.

An trial was set up to assess whether supplemental sulphur fertilizer would increase the amount of allicin in two common garlic cultivars. Treatments consisted of potassium sulphate applied to fall-planted Musik and Vernon garlic at the rate of 100 kg/ha, 200 kg/ha, 500 kg/ha, 1000 kg/ha, and 2000 kg/ha. Data analysis is pending.

Vegetable cultivar trials

Processing peas

A limited cultivar adaptation trial for processing peas was done. Cultivars tested were: Lincoln, Frosty, Paladio, Wando, Improved Laxton Progress, Thomas Laxton, Olympia, Early Sprite, Novella II, and Rondo. All cultivars tested gave satisfactory yields, with no statistically significant differences between cultivars. Unfortunately, there was not enough resources to measure ease of pod splitting, tenderness, and sugar content. These parameters will be included in future evaluations of pea cultivars for processing.

Processing carrot

The Alberta Vegetable Growers (Processing) identified carrots as a crop with potential for further acreage expansion. Unlike peas or sweet corn, carrots can be stored, which results in a longer processing window. New cultivars are regularly being released and need to be evaluated for use in AB.

In 2002 a limited trial was conducted where yield between three cut and peel cultivars (Rex 190, Royal Cross, and Kamaran) and four dicing cultivars (Sweet Bites, Rex 248, Berlanda, and New Kuroda) was evaluated. As expected the dicing cultivars yielded higher, but there were no significant yield differences between cultivars in each category. More detailed information on quality and storage parameters will be evaluated in 2003.

Pesticide Trials

Residual effects of common herbicides on potatoes

Potatoes are sensitive to a variety of commonly used persistent herbicides. In order to make optimal herbicide use and planting decisions, growers need reliable information regarding herbicide persistence and how it may affect potatoes.

Five common herbicides (SUNDANCE, ALLY, ASSERT 300, MUSTER, and PRESTIGE) that are likely to precede potatoes in a crop rotation were tested. In 2001Muster was applied to canola, while all other herbicides were applied to wheat.

Application rates followed label recommendations. In 2002 these plots were planted with Shepody and Russett Burbank potatoes. Results showed no yield loss. The fact that the preceding crops were irrigated probably contributed to reduce soil herbicide residues to levels that were not damaging to potatoes.

The influence of ACCENT® on the performance of three sweet corn cultivars

Alberta Vegetable Growers (Processing) indicated that it is in the interest of their membership to obtain a User Requested Minor Use Label Extension to allow the use of ACCENT® (nicosulfuron) on sweet corn. ACCENT® would provide post-emergence control of wild oats (*Avena fatua*), green foxtail (*Setaria viridis*), and quackgrass (*Elytrigia repens*). In order to pursue this label extension the Pest Management Regulatory Agency requested additional data on crop tolerance.

The purpose of this trial was to determine whether and to what extent ACCENT® applied at the 4-6 leaf stage will cause visible injury symptoms and yield loss on Krispy King, Jubilee Super Sweet, and Jubilee sweet corn cultivars. Treatments consisted of ACCENT® applied at the label rate (1X), twice the label rate (2X), and an untreated control.

Visual ratings and measurements of yield parameters revealed no damaging effect of ACCENT® at either the 1X or the 2X rate on any of the three cultivars. The F-values for treatment effects obtained from the analysis of variance ranged between 0.21 and 3.2, with no significant treatment effects at the 10% alpha level.

Therefore, under the conditions of this trial, ACCENT® applied at the 5-6 leaf stage to Jubilee, Jubilee Super Sweet and Krispy King sweet corn did not result in visible damage, or measurable yield loss.

Partial funding for this project was provided through a grant from AAFC - Minor Use Program Funding Initiative.

Fruit Crops

Black currant

Black currant, a highly productive crop with more juice per acre and a higher source of vitamin C than oranges, is a preferred confection and fruit drink flavor in Europe. In North America black currants are a new, but rapidly growing industry. With well over 300 acres planted, Alberta is poised to become a leader in this new industry.

Integrated crop management of black currants in Alberta

Integrated crop management practices adapted to Alberta conditions need to be developed in order to support the expansion of black currant production. Major crop management issues are insect pests, diseases, fertilizer requirements, water consumption, weed control and mulching.

This project was initiated by a grower group in the Red Deer area (Prairie Natural Processing Inc) in collaboration with the ARC-Vegreville and AAFRD. Field experiments will be done at ten orchards of participating growers. All orchards are located within a 20-minute driving distance of Red Deer. The research objectives are: 1) to compare performance and development of recommended cultivars; 2) to compare the effect of mulches on growth performance in different orchards; 3) to quantify the response to N fertilization; and 4) to assess yield benefits of drip irrigation.

This three-year project started in the spring of 2002, but only limited results were generated since most of the orchards have not yet began producing fruit. Yield data was obtained from one orchard, where a collection of cultivars were planted in 2000. The highest yielding cultivars were Ben Lomond and Ben Nevis, with respectively 0.48 kg/bush and 0.46 kg/bush. Yields were very low; presumably because of the severe drought conditions. Drip irrigation applied to Ben Nevis plants resulted in a 63% yield increase compared to no irrigation. This increase was lower than expected, probably because of delays in setting up the system. No response was observed with respect to the nitrogen fertilizer treatments, which probably reflects the lack of moisture and the fact that the fertilizer was applied when most of the vegetative growth had already taken place. Similarly there was no growth response to the different mulch treatments; most likely due to moisture stress.

This project will be continued over the 2003 and 2004 growing seasons.

Funding for this project was provided through a grant from Alberta Agricultural Research Funding Consortium, Alberta Market Gardener's Association, Alberta Professional Horticultural Growers Congress and Foundation Society, Fruit Growers Society of Alberta, and Prairie Natural Processing Ltd.

Black currant cultivar adaptation trial - 2002

This trial was established in 1999 to compare hardiness and yield performance over three to four years. Cultivars tested were Ben Alder, Ben Connan, Ben Lomond, Ben Nevis, Ben Sarek, Ben Tirran and Titania.

In 2002, Ben Alder and Ben Connan were the highest yielding cultivars, with 3.36 kg/bush and 3.00 kg/bush respectively. The remaining cultivars yielded between 0.50 kg/bush and 1.62 kg/bush. Sugar content (brix scale) was between 16.0 % (Ben Connan) and 19.2 % (Ben Nevis), except for Ben Sarek and Ben Tirran, which had readings of 12.0 % and 14.7 % respectively.

Partial funding for this project was provided through a grant from the Alberta Market Gardeners Association. All plant material was donated by McGinnis Berry Crops Ltd., Courtenay, BC.

Strawberry

In Alberta strawberries are a very important crop to a large number of U-pick operations. The fruit and vegetable program continues to support this industry by screening newly released cultivars and breeding lines for their usefulness in Alberta.

Yield data was generated for 20 cultivars. The cultivars from highest to lowest yield ranked as follows: Kent, SJ942-3, Glooscap, Eastern Kent, LL979-46, Brunswick, Mira, Cabot, L'Acadie, Mesabi, K93-20, FI09337-24, FI0971-21, Yamaska, K96-1, FIN002-187, LLSETR15, SJ9323-3, Saphire, and SJ937-1. SJ942-3 has done well in numerous trials across the country and is expected to be released in the near future.

FIN002-187 is an everbearing type that would have ranked higher if harvest would have proceeded beyond August 2nd. It showed good winter hardiness and may be a good candidate to extend production later into the season.

The collaboration of Dr. Sharokh Kanizadeh, strawberry breeder at the AAFC - St-Jean sur Richelieu, QC, is gratefully acknowledged.

Technology Transfer

Extension activities included a field day for the Fruit Growers Society of Alberta at CDCS and at CDCN, a field day at Prairie Natural Processing Inc., several presentations at the Fruit and Vegetable Highlights seminar in Lethbridge, Stettler, and Red Deer, and a presentation at the Alberta Vegetable Growers (Processing) annual meeting. Contributions were also made to newsletters of the Alberta Market Gardeners Association, the Fruit Growers Society of Alberta and the Alberta Vegetable Growers (Processing).

Grass Seed and Forage Crops Program

H. Najda and A. Kruger

The grass seed and forage crops program conducts agronomic and adaptability research to develop and provide information on grass seed production on both traditional and new forage crops.

Several trials were conducted in cooperation with other research institutions and agencies. These included the Forage and Horse Branch; Lacombe Research Centre (forages); CDCN (grass seed production); AAFC - Lacombe (forage corn) and ARC - Vegreville (grass seed production).

The following companies and institutions sponsored various research projects in 2002: Agricore United (AB); ARC; Brett-Young Seeds (MB); Cascade International Seeds (Oregon, USA); Cebeco International Seeds (Oregon, USA and the Netherlands); DLF-Jenks (Oregon, USA); Deutsche Saatveredelung (Germany); Lesco Inc. (Oregon, USA); Moore Seed Processors (AB); Newfield Seeds (Saskatchewan); Northstar Seed (MB); Parsons Seeds (ON); Pickseed Canada (ON); Pioneer Hi-Bred Ltd. (ON); The Scotts Co. (Oregon, USA); Tomorrow's Seed (BC) and Turf Seed Inc. (Oregon, USA).

Research Projects

Perennial Grass Seed Production Studies

This has become a major area of research in southern Alberta. Seed companies from Canada, the United States and Europe are now contracting irrigation and rainfed production acres throughout the province.

Agronomy trials were conducted at Brooks and Bow Island. These included fertility trials on perennial ryegrass and the completion of a companion cropping trial on tall fescue. A cooperative province-wide project headed by Dan Cole of CDCN was initiated in 2000 to determine the effects of fall-applied herbicides on different grass species for seed production. Calvin Yoder, Forage Specialist in the Peace is also a cooperator.

In 1998 the Western Grass Seed Testing Program (WGST) was initiated to provide seed yield and adaptability information to the seed industry. The trials are coordinated by the grass seed and forage crops program at CDCS and are a cooperative effort of federal and western provincial research and extension staff, and the seed industry. Testing sites are located at Fort St. John, BC; Beaverlodge, Bow Island, Brooks and Vegreville, AB; Melfort and Saskatoon, SK; Arborg and Portage La Prairie, MB.

The grass seed and forage crops program at CDCS is responsible for: seed acquisition, distribution to test cooperators and the production of an annual report for seed producers and the seed trade. This report is available on Ropin' the Web at <www.agric.gov.ab.ca/crops/forage/2002wgst report.pdf>.

Species currently being tested include Kentucky bluegrass, smooth bromegrass, chewings and creeping red, hard, meadow, mountain, and tall fescues, *Festulolium* (a cross between perennial ryegrass and tall fescue), orchard grass, perennial ryegrass, timothy, intermediate wheatgrass and blue wildrye. Results of this program have contributed to increased contract seed production not only in southern Alberta but the rest of the province and Western Canada especially of newer grass species such as tall fescue, perennial ryegrass, Kentucky bluegrass and meadow bromegrass.

Perennial Forage Cultivar Testing

Regional Forage Testing Program

This was the twelfth and final production year of the Regional Forage Testing program evaluating perennial forage species and varieties. This program was funded by AAFRD and coordinated by the Forage and Horse Branch, Lacombe Research Centre. Species tested include alfalfa, alsike and red clover, bird's-foot trefoil, cicer milkvetch, Kentucky bluegrass, smooth and meadow bromegrass, orchard grass, Italian and Westerwolds ryegrass, timothy and crested wheatgrass.

The grass seed and forage crops program at CDCS is responsible for conducting irrigated and dryland trials at Bow Island and Brooks and is also responsible for compiling and analyzing data from all the provincial sites and preparing the annual report for the Alberta Forage Variety Committee (AFVC) of the Alberta Forage Council. This testing program allows producers to base crop decisions on information from a wide range of forage varieties. Data have indicated that there are significant differences in variety performance for the different agro-climatic areas of the province.

Results of the trials are now available to the producer and industry personnel in the updated Agrifax pamphlet *Varieties of Perennial Hay and Pasture Crops for Alberta.* Agdex 120/32. This information is also available on the Internet at the AAFRD site: < www. agric.gov.ab.ca/navigation/crops/forage index.html>.

Western Forage Testing Program

The Western Forage Testing Program (WFT) was initiated in 1995. This is a cooperative tri-province (AB, SK and MB) venture which tests forage cultivars for registration purposes. In most cases, enough location years are incorporated into the testing program to provide a basis for registration and to provide data for particular agro-climatic areas. In 2002, three alfalfa cultivars and one red clover cultivar were supported for registration by the AFVC. The annual report for 2002 is available at: <www.agric.gov.ab.ca/crops/forage/2002western forage.pdf>.

Agronomic Trials

In partnership with Dr. Vern Baron of AAFC - Lacombe and sponsored by Pioneer Hi-Bred Ltd., irrigated forage trials were established at Bow Island and Brooks. The feasibility of extending the grazing and growing season with short-season corn is being investigated as a cost effective means of lowering winter-feeding costs.

DLF-Trifolium, a Danish Seed Company, is sponsoring research trials at Lacombe and Brooks, AB and Saskatoon, SK. Dormant seeding of annual ryegrasses is being investigated to determine the practicality of this practice in comparison to spring-seeded ryegrasses.

Technology Transfer

The program leader, H. Najda, provides information services to growers, industry personnel, producer and commodity organizations and other AAFRD staff. In 2002, presentations were made at several industry and producer meetings and provincial advisory committees. Two information pamphlets on forage variety performance were updated as was the information on the Ropin' the Web site. Two scientific papers co-authored by the program leader were published.

The program leader participated on the Alberta Forage Variety Committee, the Alberta Alfalfa Seed Committee, the Western Grass Seed Testing Committee, the Western Forage Testing Committee, and the board of directors of the Chinook Applied Research Association.

Greenhouse Crops Program

N. Savidov, P. Coté, L. Puchailo, J.A. Hughes, D. Terry, B. Kozak

After the restructuring of AFRD Industry Development Sector, the Greenhouse Crops Program at Brooks became the most important resource for the industry. Although, the main focus of the program is research and development, the program is also active in providing extension to the greenhouse growers in Alberta.

The greenhouse industry in Alberta demonstrated a stable growth over the last decade, which continued in 2001/2002. The goal of the greenhouse research program is to sustain this growth offering support through development of new technologies. Applied research concentrated on most important problems in the industry. Research direction decisions were made with the participation of the major industry stakeholders such as Red Hat Coop, which supported the research program by several grants during the last year. Industrial partners included Red Hat Coop, Industrial Mineral Processors, Calgary, Air Liquide, Calgary, Biosphere Technologies, Ponoka, MilleniumCoir, ON, Noviant, USA, and others. The program was also successful in receiving a number of grants from internal and external funds.

The research at Brooks has a strong market orientation. Crop diversification program was aiming to select crops, which could bring more cash to the growers and improve their competitiveness in the domestic and export markets. Branding of products was included in two projects.

Development of successful partnership inside and outside of AAFRD was a specific target for the program. The program established a productive collaboration with Business and Innovation and Ag-entreprenur Divisions as well as Livestock Development and Processing Development Divisions; programs inside CDD including plant pathology, special crops, fruit and vegetable program; and with Planning and Competitiveness Sector providing expertise and serving as a research resource in the collaborative projects.

The program continued consultations with academic, educational, provincial and federal institutions including U of A, U of S, Olds College, Lethbridge Community College, ARC - Vegreville, AAFC, NRCC Plant Biotechnology Institute, UN Development Program-Dryland Development Center, Costa Rica, University of Virgin Islands, USA, Ben-Gurion University, Israel, University of Freiburg, Germany, Stellenbosch University, South Afirca and Moscow Agricultural University, Russia.

Research Projects

Edible coatings for greenhouse vegetables

The objective of this project was to evaluate the use of different edible coatings on greenhouse vegetables to improve their shelf life. Greenhouse vegetables including cucumbers and peppers are prone to losing moisture due to thinner cuticle compared to field grown produce and require postharvest treatment to prolong their shelf life. The industry has no satisfactory packaging solution for greenhouse vegetables. At present, packaging for cucumbers uses polyethylene wrappers to decrease water loss during storage and transportation. The need for physical removal and poor sensory properties of the plastic wrapping as well as accumulation of the transpirational water inside polyethylene bags makes the greenhouse produce unattractiveto a cusumer. Peppers are not wrapped; resulting in a loss of texture and shortened shelf life. The current technology is outdated and requires improvement. Six different coatings were applied including major commercially available coatings.

Preliminary data showed that carnauba wax was the most efficient coating almost doubling shelf life of peppers. Sodium Carboxymethylellulose (CMC) coating had a positive effect on shelf life of cucumbers. This study triggered collaboration with Noviant, USA, the largest CMC producer in the world. This project was supported by Red Hat Coop, which provided a monetary contribution, and ran in collaboration with food science program at CDCS.

Selection of alternative substrates and use of zeolites for production of greenhouse vegetables in Alberta

The greenhouse industry in Alberta is based mainly on use of sawdust as a substrate because of its low price and availability. Sawdust provides appropriate growing conditions in the beginning of a crop. However, it losses stability and starts decomposing after 1-2 crops. Decomposition of sawdust imposes anaerobic and nutrient stresses on the crop roots and promotes diseases leading to yield loss and low profitability. The necessity of more stabile substrates becomes especially evident in Alberta now, when cucumber growers have adopted an annual three-crop-production system. Growers have not implemented other substrates, due to a lack of information about their use in Alberta. Several substrates with improved stability including sawdust, perlite, rockwool, coconut coir and zeolites are being tested in order to develop more efficient vegetable production in Alberta.

The preliminary experiments in 2002/2003 showed that zeolite amendments boosted yield by 10 to 15 per cent. This increase will allow Alberta greenhouse growers to increase their profit margins and be more competitive. The used substrate containing zeolite is a valuable slow release fertilizer and can be potentially marketed for secondary use in tree nurseries. The project was supported by Red Hat Coop and Alberta Greenhouse Growers Association.

Using hog manure composts with zeolites

Unique capability of zeolites to adsorb and gradually release ammonium and other nutrients suggested a possibility of producing a new material, which can serve as a substrate for bedding plants in production and retail. This new substrate is based on mixture of hog manure compost, high in plant nutrients, and zeolite. It is anticipated the substrate will contain higher content of nutrients per unit of volume without toxic effect on plants. This will decrease shipping volume in retailing business and open a new opportunities for hog manure applications. The new material is very stable compared to organic fillers like sawdust and peat in bedding plant mixtures used now and has excellent physical properties including superior water retaining capacity. Preliminary results at CDCS showed high potential for zeolite/compost mixes.

Evaluation and development of aquaponics production and market capabilities in Alberta

Aquaponics is cutting-edge technology based on recycling nutrients produced by fish and growing high value organic vegetables without synthetic fertilizers. The water is filtered by the plants and returned pure to the fish tanks. Organic food production is a rapidly growing industry in Canada and the USA and this operation plans to tie into those markets. Organic greenhouse operations are higher risk because of the greater potential for yield loss from diseases and various nutrient disorders. Aquaponics may reduce this risk because it is a soil-free technology and is an example of sustainable agriculture.

The aquaponics project at CDCS is aiming to prove economic feasibility of the new technology in Alberta. The major purpose of allocating the first pre-commercial aquaponic facility in the province at CDCS was to provide necessary plant expertise for the project by greenhouse specialists. The complexity and uniqueness of the concept of growing fish and plants in a closed system required strong involvement of experts from many areas including crop and fish production, economics and marketing. The initial data produced in Brooks Aquaponic Facility at CDCS demonstrated technical feasibility. The project is expected to continue into the 2003/2004 fiscal year to produce data for economic analysis.

Efficacy of precision placement carbon dioxide supplementation in greenhouse sweet pepper and long English cucumbers production

The program continued collaboration with Air Liquide in liquid carbon dioxide applications in greenhouse production.

The efficient use of carbon dioxide supplementation in Alberta greenhouse vegetable production represents a significant opportunity to increase yield. The focus of

the project was to design a carbon dioxide supplementation system to improve the distribution of carbon dioxide within the plant canopy and define the parameters that allow for cost-effective carbon dioxide supplementation under southern Alberta greenhouse growing conditions.

The objective of the fifth year of the study was to demonstrate the benefits of liquid CO_2 applications when used at lower concentrations from 350 to 450 ppm. This study was triggered by increased prices on liquid CO_2 in the market. The results showed sustainable 10-15% increase in yield, which will allow cost-effective liquid CO_2 applications.

Cultivation and Assessment of *Lepidium campestre* as source of glucoraphanin

This project is conducted in collaboration with special crops program at CDCS. It has been showed that a number of *Brassica* species including broccoli and *Lepidium* are capable of accumulating glucoraphanin. The product of glucoraphanin degradation in mammalians, sulforaphane, was shown to possess anti-carcinogenic activity.
The greenhouse experiments helped to isolate three lines of Lepidium accumulating increased amounts of glucoraphanin. The experiments are evaluating the effect plant age and stress have on glucoraphanin accumulation in *Lepidium* are in a progress.

Greenhouse crops program and fruit and vegetable program partnered to form the Alberta Nutri-Fruit and Vegetable Initiative (ANVI). ANVI is a new umbrella organization in Alberta aiming to coordinate activities related to quality enhancement and development of added value products in the fruit and vegetable industry. Projects under the ANVI umbrella include a feasibility study on vegetables enriched with calcium and the development of nutritionally enhanced edible coatings to improve shelf life of vegetables. Using the positive result from these projects, Alberta's growers will be producing and marketing the first functional vegetables in Canada.

Technology Transfer

The program leader N. Savidov, provided extension service to growers department and industry personnel. Telephone and on-site consultations with greenhouse growers regarding crop management concerns and problems comprise a large part of the extension activities. Transferring crop production expertise regarding new crops and improved production techniques and technology is also a strong component of the extension service.

Several presentations were delivered at industry and producer meetings.

The greenhouse crops program also has a grower training program, which provides hands-on crop management and production training to individuals interested in becoming commercial growers. This program has produced growers who have gone on to become established owner/operators of successful commercial greenhouse businesses.

Integrated Crop Management Specialist Extension Program

R. Dunn and T. Wallace

Technology Transfer

Extension program objectives include:

2002 Field Days and Tours

Six tours were planned along with AAFRD staff, partners and industry at Carmangay (3), Lethbridge (2), Bow Island, and Magrath. Staff participated and or spoke at 3 additional industry planned events. Total farmer contact is estimated at 450 and industry contact at 75.

Staff supported provincial and regional diagnostic field schools at Oyen, Elerslie and Vegreville throughout the summer.

Demonstration and Research Support

Trap cropping for cabbage seedpod weevil (CSPW), an integrated crop management practice suitable for this emerging canola pest, was demonstrated at 4 field scale sites in partnership with Dr. Hector Carcamo, AAFC - Lethbridge. This included two fall seeded and two early spring seeded canola's on the outer edge of spring seeded fields with the intent to concentrate CSPW and limit the need for foliar insecticide application to the trap border. Sites were monitored for insect density, insecticide control and yield impacts. Trap cropping for flee beetle was also demonstrated at two southern Alberta sites using seed treated insecticide applied to the outside edges of a canola and mustard field.

Planning support was provided for field trials by CDCS research staff and Irrigation Branch staff. This included trials related to chickpea, mustard, corn, canola and cereals at several sites including the CACDI Irrigation demo farm at Lethbridge.

Planning and staff supervisory support was also provided for demonstrations, field trials and activities of the Southern Applied Research Association.

Meetings and Conferences

Planning support was provided for numerous workshops, conferences and meetings throughout the province. Major events included the Southern Alberta Conservation Association Conference and Trade Show at Medicine Hat and the Provincial Agronomy Update at Lethbridge.

Staff participated in 5 industry advisory meetings to clarify issues and develop strategies related to crop industry growth (mustard and pulse) and pest issues (insect, disease and weed).

Extension support

Presentations were prepared and given in response to over 25 requests for information or skill development related to cereal, pulse and oilseed agronomy or cropping systems.

Agronomic support and training was also provided to industry clients through one on one consultation and electronic delivery. This was provided in concert with provincial ag-info center staff on cropping issues related to the southern Alberta area.

Nursery Crops Program

C. Murray and N. Seymour

The nursery crops program is focused on research into cultural management practices for commercial nursery production of both field and container-grown plants and the evaluation of new plant cultivars. A close association with Landscape Alberta Nursery Trades Association (LANTA) allows for excellent communication with the commercial industry.

The program leader also provides information services to other AAFRD staff and to producer and commodity organizations. Details of research trials are presented in *Nursery Crops Program 2001*, CDCS Pamphlet 2002-8.

Research Projects

Woody Plant Evaluation Trials

Prairie regional trials

The Prairie Regional Trials (PRT) were established in 1958 to evaluate the hardiness of woody plants on the Canadian Prairies and continue today in cooperation with AAFC-Morden, MB. The plants in the PRT are evaluated for five years at seven prairie sites including CDCS. The growth and landscape quality data collected each year are sent to Morden where a report is produced approximately every three years and is now available at the website <http://res2.agr.ca/winnipeg/prt59_58.html>. In 2002, eleven new rose selections were planted at CDCS.

Regional woody plant test program

Since 1983, AAFRD staff, the LANTA Growers Group and Research Committees have cooperated to develop and maintain The Regional Woody Plant Test Program (RWPTP). New tree and shrub introductions, generally from North America, are evaluated for five years at six different sites representing different climatic regions in the province. The CDCN site finished evaluating plant material in 2002. Growth and landscape quality data are collected each year. Six new selections were planted at each site in the spring of 2002 and three new selections were planted in the fall of 2002.

For more information about the RWPTP from 1983-2000 see *Regional Woody Plant Test Project, Summary Report 2000, CDCS Pamphlet #2001-3* or at <http://www.agric.gov.ab.ca/crops/trees/rwptp/index.html>.

The University of British Columbia plant introduction program

The University of British Columbia (UBC) Botanic Garden Plant Introduction Program selects superior plant material from many sources to test for suitability for introduction into the nursery-landscape industry. In 1998, the UBC selection, *Lonicera* 'Son of Mandarin', began evaluation at CDCS. For more information on the UBC program go to <http://www.hedgerows.com/UBCBotGdn/UBCResearch.html>.

Alberta perennial gardens trial

In response to the huge growth in interest and sales of herbaceous perennials, the Calgary Zoo and Botanic Garden, LANTA Retail Operators Commodity Group and CDCS cooperated to develop the perennial demonstration and evaluation garden from 1999-2001. The trial garden was at the Calgary Zoo in the Dorothy Harvie Gardens. It was completed in 2001.

A second phase of the trial began in the spring of 2002 with additional demonstration gardens at the Olds Botanical Gardens, Olds College, Olds, AB and at the Muttart Conservatory in Edmonton, AB. The project objectives are: 1) to evaluate new species and cultivars of perennials for hardiness and landscape quality under Alberta conditions; 2) to compile and publish the results for the public, retailers, growers and landscape professionals 3) to increase the knowledge about new perennials for the public, retailers, growers and landscape professionals.

The summary of the data collected the first three seasons has been published in the technical document, *Perennial Trial Garden Evaluation 1999-2001*, and a general audience brochure. Both are available from the LANTA Retail Operators Commodity Group. Information is also posted on the Perennial Trial Garden web site <http://www.albertaperennialtrials.ca/>.

University of Saskatchewan perennial trial

The U of S, is conducting trials on perennials for the prairies. Overwintering the material is one of the most crucial factors in selecting suitable cultivars. To obtain overwintering data in different climate zones, the selections must be evaluated in different locations. CDCS is evaluating 9 dianthus, 5 asters and 10 geranium selections for winter hardiness.

Evaluation The evaluation of six systems of holding harvested trees during the shipping season

When trees are harvested, then balled and burlapped, as little as 5% of the root system is retained within the rootball. The remaining small root system must provide sufficient water and nutrients for the top to continue to grow and to develop replacement roots while the tree is being held before moving to its final location in the landscape. It is also important that the trees do not root out into the soil surrounding the rootball. These newly developed roots are generally broken and destroyed by moving and shipping resulting in a second transplant shock for the tree.

Brandon elm trees were harvested with a tree-spade, wrapped in burlap and placed in wire baskets and transported to CDCS in early June 2002. They were placed in a holding area in one of six systems: 1) placed back into hole of the same size (control); 2) placed into hole of same size with dual layer plastic bag around rootball; 3) placed back into hole with 1/3 of basket above ground; 4) placed on surface of soil with dual layer plastic bag around rootball; 5) placed on geotextile on soil surface and completely mulched with wood product; 6) placed into hole of same size lined with geotextile. The trees were irrigated throughout the season.

In the fall, top-growth was measured; roots that developed within the rootball were harvested, dried and weighed. The data were collected for the roots growing outside of the rootball into the surrounding soil or mulch. No significant differences were found in the growth rates or in the amount of roots inside the rootball.

The roots growing out of the rootball were significantly greater for the mulched treatment (5) than the remaining treatments, followed by the 1/3 above ground treatment (3) and the control (1). The roots that developed outside the rootball may be damaged when the trees are moved to their final destination resulting in a further transplant shock.

A further test of these holding systems will be to move the trees into the landscape after holding them for a season and to observe transplant and overwintering success.

Chickadee Birch Grafting Trials

Betula papyrifera 'Chickadee' is a hardy white birch selection with a narrow crown, bright white bark and bright yellow fall color. However, it is difficult to root and that has limited its availability in the landscape trade. Past attempts to propagate Chickadee by hardwood and softwood cuttings have given very poor rooting success. Alternate methods of asexual propagation are through budding or grafting. This trial was set up to develop a protocol for propagating Chickadee with spring grafting. The extensive spring sap flow in birch prohibits grafting until the development of the second leaves when sap flow is reduced.

Scionwood of Chickadee birch was collected in March and wrapped in moist paper towels and kept dormant in a freezer until grafting took place. Two-year-old white birch seedlings were lined out in a plot at CDCS on May 21. The seedlings developed second leaves by June 19, and the first grafting was completed. Grafting dates was done twice more at two week intervals. The scion was grafted onto the rootstock by bark-grafting.

Unfortunately few grafts took for any of the treatments. With the late spring, the seedlings were planted late and therefore the treatments applied much later than desired. This trial will be repeated in 2003 using the already established seedlings.

Measuring temperature fluctuations of container-grown woody plants under poly-blankets

The root systems of many container-grown plants will survive to –8°C; thus winter protection such as a thermal blanket must provide adequate protection from the cold and also minimize temperature fluctuations, which can also lead to tissue dieback. The temperature of container media was measured in containers stacked to 1.2 m and completely covered for the winter with a blanket made with a poly cover and a layer of microfoam insulation.

Thermocouples were inserted into the potting medium of containers in the north, south, east, west, top and bottom of the pile. The temperature of the air inside and outside the pile was also measured. There were minor fluctuations in daily average temperatures inside the pots with the lowest temperatures, about –12°C, recorded in pots on the north side in late January for three days until those pots recovered to about –8C. The container piles were uncovered in the second week of April.

Plant collections

Plant collections have been developed and maintained at CDCS as a living reference collection for use by horticultural professionals and the general public. The **Golden Prairie Arboretum** was established in 1981 at CDCS. The collection now contains 312 species of 68 genera for a total of 531 deciduous trees and shrubs. These plants represent most of the deciduous woody plant species that can be grown on the prairies. A complete listing of the collection is available in *Golden Prairie Arboretum, ASCHRC Pamphlet 93-1.* The **Forever Green Pinetum** collection of coniferous trees and shrubs at CDCS was established in 1986. At present it contains 26 species of nine genera for a total of 120 trees and shrubs. A complete listing of the collection is available in *Forever Green Pinetum, ASCHRC Pamphlet 93-12.* The **Rose Garden** contains 241 specimens, many of which are unique to the CDCS collection. Many early Canadian rose cultivars and notable crosses of Canadian rose breeders, Skinner, Bugnet and Wallace are maintained in the collection. The rose garden underwent a major rejuvenation in 2002.

Technology Transfer

Technology transfer to the growers is accomplished through work with the LANTA Growers Group, Western Nursery Growers Group, nursery visits as well as by the production and distribution of the Nursery Crops Trial Report, magazine articles and the presentation of seminars. In 2002, the nursery crops leader presented a seminar on research at the Alberta Horticulture Congress. The Program leaded participated in the XXVI Internation Horticulture Congress in Toronto in August 2002.

Plant Pathology Program

R.J. Howard, K.F. Chang, S.I.N. Lisowski, D.A. Burke and D.L. Slomp

The plant pathology program has a mandate to conduct applied research on important diseases of horticultural, forage and specialty crops. This research encompasses field, laboratory, growth chamber, controlled environment storage and greenhouse experiments, as well as disease surveys. Findings from this work and from the research of other cooperatingscientists are presented to commercial producers through technology transfer programs; to the scientific community via papers and abstracts in peer-reviewed journals and posters; and oral presentations at meetings and conferences. The plant pathology program also provides support services to crop production research programs at CDCS.

Diseases of Pulse Crops

Evaluation of fungicidal seed treatments against rhizoctonia and fusarium root rots of dry bean

Two trials were conducted at CDCS, one for controlling rhizoctonia root rot of dry bean and the other for fusarium root rot. Seeds of cv. Envoy were treated with APRON (12.8 g/100 kg seed) + CROWN (88 g ai/100 kg seed) or APRON MAXX (6.25 or 12.5 g ai/100 kg seed). Inoculum of *Rhizoctonia solani* or *Fusarium avenaceum* was incorporated with the seed. Nontreated seeds were planted as inoculated and non-inoculated controls. Seedling emergence and seed yield were significantly greater than the inoculated control for all seed treatments in both trials.

Evaluation of foliar fungicide treatments to control anthracnose of dry bean

Pre- and post-inoculated trials were conducted using seed of cv. US 1140, which was sown in pots and grown in a greenhouse at CDCS. Pre-inoculated treatments were sprayed with a conidial suspension of *Colletotrichum lindemuthianum* (10^6 spores/mL). Two days later, foliar fungicide treatments were applied to all pots, except for the inoculated and non-inoculated control treatments. Post-inoculated treatments were sprayed with the conidial suspension two days after treatment with foliar fungicides.

Fungicide treatments consisted of QUADRIS (125 g a.i./ha), BRAVO (1000 g a.i. ha), HEADLINE (100 g a.i./ha), or DITHANE (1688 g a.i./ha), as either single or double treatments, with the second application 14 days after the first. BRAVO and QUADRIS were also applied in alternating sequences.

Disease incidence and severity were significantly greater ($P>0.05$) than the inoculated control for all seed treatments in the pre-inoculated trial. Among the treatments in this trial, disease incidence was greatest for BRAVO, DITHANE, the double BRAVO and DITHANE treatments, and the BRAVO/QUADRIS treatment. Disease incidence was lowest for the single and double applications of QUADRIS and HEADLINE, and the treatment using QUADRIS then BRAVO. Disease severity was significantly reduced by every foliar spray treatment in this trial compared to the inoculated control. Among the treatments in the post-inoculated trial, the double and single applications of BRAVO showed the highest disease incidence, followed by BRAVO/QUADRIS, the single and double applications of DITHANE DG, and the double application of QUADRIS. The single and double applications of HEADLINE and the single application of QUADRIS ranked among the lowest for disease incidence. Disease severity was significantly higher for the BRAVO treatments (either single or double application) compared to the other foliar sprays.

Evaluation of fungicidal seed treatments for the control of rhizoctonia root rot of dry bean, soybean and chickpea

Three trials were set up at CDCS in the spring of 2002 to control rhizoctonia root rot of dry bean (cv. US1140), soybean (cv. Gaillard) and chickpea (cv. B-90). Seed was treated with the experimental fungicide L1050 (3.25 mL/kg seed), STILETTO (4.4 mL kg seed) or ALLEGIANCE (0.16 mL/kg chickpea seed, 0.128 mL kg soybean seed), either alone or in combination with CROWN (3.0 or 4.5 mL/kg seed), VITAFLO 280 (3.3 mL/kg chickpea seed, 2.6 mL/kg soybean seed), FLINT (0.1, 0.2 or 0.4 g kg seed; 0.05 or 0.1 g/kg soybean seed), or L1030 (0.5 mL/kg soybean seed). *Rhizoctonia*-inoculated and non-inoculated controls were seeded along with the chemical treatments.

On dry bean, emergence was significantly higher for all seed treatments compared to the inoculated control. Yield was similar among all seed treatments, but was significantly greater than the inoculated control for L1050. Emergence and yield for the fungicide treatments were generally below that of the non-inoculated control.

On soybean, emergence was significantly higher for all seed treatments, except for ALLEGIANCE alone and VITAFLO 280 alone, than for the inoculated control. Emergence was significantly higher ($P\geq0.05$) for STILETTO, ALLEGIANCE + L1030, and ALLEGIANCE + VITAFLO 280 than for either ALLEGIANCE or VITAFLO 280 alone. Yield was similar among all seed treatments and both controls.

On chickpea, emergence was significantly higher than the inoculated control for all seed treatments, except ALLEGIANCE alone, L1050, and ALLEGIANCE + FLINT at the lowest and highest rates. These treatments produced significantly lower emergence compared to STILETTO and ALLEGIANCE + CROWN at both rates. Yield was significantly higher for all seed treatments, except for ALLEGIANCE alone, compared to the inoculated control.

Survey of dry bean fields in southern Alberta for bacterial diseases

Program staff, assisted by field representatives of Agricore United's Alberta Bean Division, Bow Island and Taber, surveyed 14 commercial bean fields in the Bow Island, Taber, Vauxhall and Rolling Hills areas in mid-August to determine the incidence of common blight (*Xanthomonas campestris* pv. *phaseoli*), halo blight (*Pseudomonas syringae* pv. *phaseolicola*), brown spot (*Pseudomonas syringae* pv. *syringae*) and bacterial wilt (*Curtobacterium flaccumfaciens* pv. *flaccumfaciens*). Incidence and severity of these diseases were measured on ca. 100 plants collected throughout each field. Common blight and/or halo blight were observed in every field, with incidence levels (% plants infected) in excess of 50% in some cases. Both leaf and pod infections were seen in many fields. Plants suspected of having bacterial wilt were collected from three fields and bacterial isolates are awaiting confirmation. Other foliar diseases observed included white mold (*Sclerotinia sclerotiorum*), gray mold (*Botrytis cinerea*), alternaria leaf spot (*Alternaria alternata*), anthracnose (*Colletotrichum lindemuthianum*), bronzing (possibly ozone damage), and chlorosis (nutrient deficiency). A disease of unknown etiology, tentatively named early yellowing syndrome, was observed in one field in the Rolling Hills area.

Evaluation of fungicidal seed treatments against botrytis seedling blight of lentil and chickpea

Two trials with similar design were conducted at CDCS and at ARC - Vegreville using the lentil cv. Laird. An additional trial was conducted at CDCS using chickpea cv. B-90. Both chickpea and lentil seed was treated with L1050 (3.25 mL/kg seed), VITAFLO 280 (3.3 mL/kg seed), CROWN (3.0 or 6.0 mL/kg seed), or with ALLEGIANCE (0.128 mL/kg seed), either alone or in combination with FLINT at 0.1, 0.2 or 0.4 g/kg seed. *Botrytis cinerea* inoculum was incorporated into soil at the time of seeding. At ARC -Vegreville, emergence was significantly greater for all seed treatments in the trial compared to the inoculated control.

Emergence for plots treated with CROWN at the higher rate was significantly greater than for those treated with the lower rate of this product or with L1050. Seed yield was greater for both CROWN treatments compared to ALLEGIANCE + FLINT and both controls. At CDCS, emergence was significantly greater for seed treated with CROWN at the lower rate or L1050 compared to the inoculated control and to ALLEGIANCE, either alone or combined with FLINT.

For the chickpea trial, emergence was significantly higher for all seed treatments compared to the inoculated control. Seed yield was significantly higher for all seed treatments, except ALLEGIANCE + STILETTO, ALLEGIANCE + CROWN at the higher rate, and ALLEGIANCE + FLINT at 0.2 mL/kg seed, compared to the inoculated control.

Evaluation of foliar spray treatments for the control of ascochyta blight of chickpea

The cv. Sanford was seeded into experimental plots at CDCS and treated with four foliar fungicides [BRAVO 500F (1.0 or 1.5 kg/ha), DITHANE DG (1.68 or 2.44 kg ai/ha), HEADLINE (0.1 kg/ha) or QUADRIS (0.125 kg/ha)] using eight different spray schedules. All treatments and one control were inoculated with conidial suspensions of *Ascochyta rabiei*. Disease incidence and severity were significantly lower than the inoculated control for all treatment schedules in the trial. These schedules, except for DITHANE DG alone, also reduced disease incidence and severity compared to the non-inoculated control, which had become infected by secondary airborne inoculum. Insertion of a HEADLINE treatment into the DITHANE DG schedule resulted in

significantly lower disease incidence compared to DITHANE DG alone. None of the treatments significantly improved yield over the controls.

Evaluation of fungicidal seed treatments to control botrytis seedling blight of chickpea

Seed of cv. Myles naturally infested with *Botrytis cinerea* (10-20%) was treated with ALLEGIANCE (0.16 mL/kg seed) alone as a control or in combination with VITAFLO 280 (3.3 mL/kg seed) or CROWN (3.0 and 6.0 mL/kg seed). Emergence was similar for all treatments, but seed yield was significantly higher where CROWN was applied at 6.0 mL/kg seed with ALLEGIANCE than where ALLEGIANCE was applied alone.

Occurrence of chickpea diseases in Alberta in 2001 and 2002

In 2001, 50 commercial chickpea fields were surveyed for diseases during the third week of July. Forty-one showed very low levels of ascochyta blight and root rot severity, likely due to the hot, dry weather conditions that prevailed in the summer. In 2002, 53 fields were visually assessed in August for ascochyta blight incidence and severity and for root rot incidence. No ascochyta blight was observed at CDCN in central Alberta due to extremely dry conditions. However, unusually cool, wet weather dominated southern Alberta and caused a severe outbreak of ascochyta blight in most fields. Plants of kabuli cv. Sanford became heavily infected with ascochyta and pycnidia formed, while disease incidence and severity were low in the desi cvs. CDC Nika and Anna. Abundant rain and low temperatures in late summer resulted in vigorous, indeterminate growth and delayed harvesting of many fields until October. As a result, ascochyta infections spread to the seed coat and drastically reduced seed quality. Gray mold and white mold also heavily infected Sanford plants in two trials at CDCS, but did not seriously affect most commercial fields. Patches of fusarium root rot occurred in fields after plants reached the flowering stage.

Diseases of Essential Oil Crops

Responses of mint cultivars to fusarium root rot

Twenty-two cultivars of *Mentha* spp. were tested for resistance to *Fusarium* sp. under greenhouse conditions. Seedlings were propagated in plug trays and inoculated with 3.0 g of ground grain inoculum/plant. Six weeks after inoculation, rhizomes and roots were washed and the rhizomes, stolons and stems were rated for disease incidence and severity. USDA *Mentha* 108 was the only cultivar to have no mortality and no disease. Peppermint had a high rate of mortality and disease incidence.

Chemical control of peppermint root rot under greenhouse conditions

The fungicides BENLATE, BOTRAN, EASOUT, MAXIM, TERRACLOR, ROVRAL and TILT were tested for their efficacy to control *Fusarium* spp. and *Rhizoctonia solani* under greenhouse conditions. Suspensions of these chemicals were used to drench infested pots. EASOUT and TILT were effective against *Fusarium*, and all of the fungicidal treatments tested reduced seedling mortality and stolon rot caused by *Rhizoctonia*. The highest plant biomass was produced from the EASOUT treatment.

Diseases of Fruit Crops

Diseases of currant and gooseberry in central and southern Alberta in 2002

In cooperation with C. Neeser and L. Hausher (CDCS) and K. Fry (ARC - Vegreville), 19 commercial and 3 research orchards of currant and gooseberry were surveyed between mid-July to the first week of September, 2002 for occurrence of powdery mildew (*Sphaerotheca mors-uvae*), leaf spot (*Alternaria* spp.), rust (*Cronartium ribicola*) and root rot. The black currant cvs. Ben Alder and Ben Lomond were highly susceptible to rust, but resistant to powdery mildew. Rust was epidemic in all black currant orchards surveyed in southern Alberta due to the cool, wet weather. Infections began in early August and, by mid-September, the lower leaves of susceptible plants were entirely covered with pustules. Powdery mildew was severe on young shoots

and leaves of some experimental black currant cultivars growing at CDCS, but not in commercial fields. The black currant cv. Titania and lines of gooseberry growing in the same orchard were immune to both powdery mildew and rust. Stem canker (*Nectria cinnabarina*) was observed in one orchard in central Alberta. Alternaria leaf spot occurred at a low incidence in many orchards. Hinnonmaki - Red and Hinnonmaki - Yellow gooseberries were especially susceptible to *Alternaria* spp. in an orchard near Red Deer. In central Alberta, no powdery mildew or rust occurred on black currants; however, root rot caused up to 20% mortality in some areas of several first-year orchards. Root rot also occurred in one black currant orchard grown under irrigation near Lethbridge. The major microorganisms isolated from the roots were *Fusarium* spp. (85%), *Alternaria* spp. (33%), *Pythium* spp. (28%) and unidentified bacteria (23%). Other minor microorganisms were *Rhizoctonia solani*, *Sclerotinia* sp., *Trichoderma* spp., and *Penicillium* spp.

Diseases of Vegetable Crops

Occurrence of diseases

In southern Alberta, alternaria leaf spot of bok choy was commonly observed (100% infection). Lower leaves were severely infected and many had to be trimmed off before they could be marketed. This disease was less common on suey choy. Approximately 10% of the suey choy crop and 1% of the bok choy crop were lost from bacterial soft rot infection. Some varieties of processing pea and snow pea suffered from ascochyta infection, causing approximately 10% yield loss. Fusarium root rot also occurred on some vegetable pea crops. Aster yellows of carrot was common, but at a lower incidence than last year. Fusarium basal rot of garlic was very severe in a field trial at CDCS. In central Alberta, vegetable diseases were not as serious due to the dry growing conditions. Club root of suey choy, bok choy and cauliflower was severe in small patches in a market garden near Leduc. Infected plants showed lower leaf yellowing, stunting, wilting and eventually died. The disease was more severe in low areas where water collected. Zucchini end rot (10% loss), squash leaf blight and aster yellows of carrot and celery also occurred.

Diseases of Potatoes

Evaluation of QUADRIS fungicide against alternaria blight and early blight on potatoes

To compare the relative efficacy and to gather data to assist Syngenta Crop Protection Canada in getting registration for aerial application of QUADRIS (azoxystrobin) for potato early blight, QUADRIS was applied by ground sprayer and airplane in three commercial fields in the Taber area. Blight levels in strips sprayed by air were generally higher compared to those sprayed with a ground rig; however, these differences were not statistically significant. Blight levels very low in all three fields, which reflected the effectiveness of the preventative fungicide spray programs used by the cooperating growers.

Efficacy of seed treatment fungicides against silver scurf and verticillium wilt of potato

SENATOR (thiophanate-methyl) and ENG0500, an experimental fungicide from Engage Agro Corporation, were applied to seed pieces of cv. Shepody and planted in a replicated field trial at CDCS. Seed pieces naturally infected with *Helminthosporium solani* were used for the silver scurf trial, whereas inoculum of *Verticillium dahliae* was placed in the row with seed pieces in the verticillium wilt trial.

Disease levels were high in both trials. Stand counts were taken 4-6 weeks after planting, and data on the incidence of verticillium wilt based on foliar symptoms were taken on two dates during the growing season. Tubers were harvested in September.

graded and yields determined. Tuber samples will be retained in cold storage for three months and then assessed for the incidence and severity of silver scurf and verticillium wilt. Data analysis is pending.

Resistance of potato breeding lines to early blight under field conditions

Twenty-five breeding lines and cultivars from the Western Canadian Potato Breeding Program based at AAFC - Lethbridge were screened for resistance to early blight (*Alternaria solani*) in a naturally infested field plot at CDCS. Visual estimates of disease incidence and severity were taken in September when disease levels were highest. Data analysis is pending.

Technology Transfer

Program staff spoke at five growers' and professional meetings in 2002. A workshop for county and industry people doing bacterial ring rot inspections of commercial potato fields was held at CDCS in July. Two refereed scientific papers, 4 abstracts, 3 posters, 10 research reports, 21 Pest Management Research (PMR) reports, and 6 extension articles were published. Staff were involved in the activities of several professional societies and advisory committees.

Assistance was provided to 20/20 Seed Labs to diagnose several diseased plant specimens. Program staff provided advice on disease identification and management to Centre staff and growers as requested.

R.J. Howard retained an Adjunct Professorship in the Department of Agricultural, Food and Nutritional Science at the University of Alberta. K.F. Chang served as a member of the Prairie Registration Recommending Committee for Grain (PRRCG) and was chairperson of the vegetable diseases subcommittee of the Western Committee on Plant Disease.

Potato Agronomy Research Program

M. Konschuh, S. Dalpé, and M. Nielsen

The objectives of the potato program are to foster increased production efficiency and competitiveness of the potato industry in Alberta, and sustained industry growth and development. Research objectives include applied research in the areas of vine management, crop rotation, nutrient management, tuber initiation and tuber set control, seed physiology, plant populations, and seed piece management. New information on potato agronomy is packaged and transferred to Alberta's potato producers, packers and processors.

AAFRD participates in the Western Canadian Potato Breeding Program by conducting regional trials, disease resistance screening, storage trials, and processing and quality evaluations. The primary objective of the breeding program is to select improved potato varieties adapted to the southern prairies. As one of six cooperative test sites in the Western Canadian Potato Breeding Program in 2002, the potato agronomy research program at CDCS conducted Advanced Adaptation Level 1 and 2 trials, Prairie Early Replicated Trial (80 and 95 day harvests), Prairie Maincrop Replicated Trial, the North Central Trial, and a Spacing Trial. Performance of test lines in these trials is evaluated by the breeder, test site cooperators and industry staff.

Research Projects

Prairie potato regional trials

Varieties needed by the industry include: a chipping variety that is more stable in long-term storage; an early chipping variety that will yield well and chip by the third week in July; an attractive fresh-market red potato that holds color in long-term storage;

a maincrop, fresh-market and french fry potato that is earlier than Russet Burbank and has better quality. The program is managed by potato breeder, Dr. Dermot Lynch, AAFC-Lethbridge, who initiates all crosses and evaluates preliminary selections at the Vauxhall substation. Final testing is done at the regional sites.

Approximately 120 lines were grown in the four replicated regional trials at CDCS. Data were collected on 30 to 40 agronomic and quality factors including yield, maturity, specific gravity, culinary and processing quality. Another 28 lines were grown as part of a North Central Trial comparing breeding material from Alberta with that of programs located in the north central USA. Data from the Regional Trials and from the North Central Trial were sent to Dr. Dermot Lynch at AAFC-Lethbridge for analysis and presentation to the Cultivar Registration Recommendation Committee of the Western Potato Council.

Effects of in-row spacing on yield and quality of potato selections

Twelve cultivars and advanced lines from the regional trials were planted at three in-row spacings in four replicates in a randomized complete block design. The cultivars/lines planted were Atlantic, Russet Burbank, Shepody, Jaqueline, Serafina, V0168-3, V0497-1, V0725-1, V0852-2, V0910-6, V0931-9, FV12255-6. The in-row spacings were 9, 12 and 15 inches. Yield, size distribution and quality data were measured.

***Rhizoctonia* control trial**

Several biocontrol and chemical seed piece treatments were used to control stem canker and black scurf on fresh market potatoes grown from seed with visible *Rhizoctonia solani* (black scurf) sclerotia. Treatments in the second year of the study included MAXIM PSP, Quadris in-furrow, SENATOR, two rates of ENG0500, two rates of L1210-A1, L1049-A1 + G7050-00, *Trichoderma*, and three rates of 94815. Six replicates of Yukon Gold and Russet Burbank varieties were used in the second year of the study. Date of emergence, stand counts and stem counts were taken during the season. At approximately 50 days after planting, 10 hills were hand dug and stem canker was assessed. The remaining potatoes were top killed in late August and harvested in September. Tubers were graded and samples of 25 marketable tubes were stored for several months at 8°C and then assessed for black scurf. Preliminary results from the trial were presented at the PGA annual meeting and further analysis is currently underway.

Russet Burbank vine management

Eight vine kill strategies were studied in three commercial fields of Russet Burbank potatoes near Taber, AB to determine how much tuber bulking occurs during vine kill and how various methods of vine kill affect tuber quality. Yield data, size distribution, specific gravity, stem-end discoloration and fry quality were assessed. This was the second year of a two to three year study. In 2002, no bulking was observed in two cooperator fields during the two weeks before harvest, but in one cooperator field, bulking averaged 0.14 ton/ac per day in the area of the field not desiccated. The treatment giving the greatest yield varied with each field. In all three fields, the maximum difference in yields between treatments was only 2 ton/acre. Yields obtained from most treatments were not significantly different from the control (green) or from one another. The yield response largely depended on the status of the potato crop in each field and environmental conditions during the harvest season.

Potato Vine Management with Desiccants - Syngenta

A a contract study with Syngenta Crop Protection Canada was done to compare REGLONE to IGNITE as a desiccant on potatoes. Rate of desiccation, skin set, effectiveness of the desiccant, yield, specific gravity, and tuber quality at harvest and after several months of storage were assessed.

Effect of Chitosan Seed Coatings on Russet Burbank Potatoes

A contract study for Farrson Chemicals of Washington State was conducted to compare root mass, yield and grade between Russet Burbank potatoes treated with a commercial fungicide seed treatment and those treated with fungicide plus chitosan

formulations. A low viscosity seed coating, a high viscosity seed coating and an in-furrow at planting preparation were compared. There was a trend toward higher root mass and yield (total and marketable) with the high viscosity chitosan seed coatings.

Effects of Seed Physiology, In-Row Spacing, and Harvest Date on Yield of Wedge Cut Potatoes

A contract study with Maple Leaf Potatoes was conducted to determine the effect of seed physiology, in-row spacing, and harvest date on the production of 3 to 4 inch tubers of Russet Nugget and V0852-2. Seed was warmed to 55°F, 60°F, or 65°F for two weeks before cutting to influence seed physiology. In-row spacing of 8, 10 and 12" were examined. Harvest was conducted 118, 122 and 134 days after planting. Yield, grade and potato quality were assessed for each treatment.

Other

Some opportunistic research was also undertaken on late-season hail in potato crops. Hailed fields were paired with comparable non-hailed fields managed by the same growers. Samples were taken as soon after hail as possible, and just prior to harvest to determine the extent of damage hail has on yield potential and potato quality.

Technology Transfer

Information was provided by the program leader, M. Konschuh, to producers, processors, and other industry staff as requested. Information about cultivar evaluations and research projects was presented at industry meetings and through direct contact.

The majority of the extension responsibilities for the potato program at CDCS are handled by Lori Delanoy, AAFRD extension agronomist.

Potato Agronomy and Extension

L. Delanoy

Technology Transfer

The objectives of the potato program are to provide sound agronomic advice and assist the industry as a whole in improving potato quality and maximizing yield. This is done for Alberta's potato industry through direct contact, newsletters, factsheets, workshops, conferences and presentations at these workshops and conferences.

On-farm demonstration – Alberta Mobile Potato Demonstration Farm (AMPDF)

The extension agronomist, in association with the Potato Growers of Alberta, organized several on-farm demonstration projects. Each of these projects was compared with a controlled check treatment.

QUADRIS (azoxystrobin) was applied in-furrow to Russet Burbank to monitor yields and rhizoctonia control. Yield data was calculated for each treatment. This trial will be repeated in 2003.

RIDOMIL (metalaxyl) was applied in-furrow to Russet Burbank. Yield data was calculated for each treatment.

QUADRIS (azoxystrobin) and RIDOMIL (metalaxyl) were combined in an in-furrow treatment. Yield data was calculated for each treatment.

Two rates of nitrogen (in the form of 28-0-0) were applied with different water concentrations to monitor foliar burning on the potato plant. Yield data were calculated for each treatment.

In mid-July, flailing vines in a designated area created a hail plot. Yield data were calculated. Quality has yet to be tested.

Three separate rates of potassium chloride were replicated in a field of Russet Burbank. Yield and quality analysis showed no significant differences between treatments. This trial was repeated from 2002.

Side-by-side insecticide demonstrations showed efficacy, or lack thereof, of one product over another.

Industry field extension

The extension agronomist assisted industry with various management decisions – excess water, low nitrogen levels, leaching nutrients – beginning early in spring through to the end of harvest. Growers and industry experienced a very challenging year.

Industry extension

The extension agronomist attended potato information seminars and conferences in both Canada and the United States. Information on new and upcoming chemicals, cultural practices and much more was obtained and is available.

The extension agronomist worked closely with Western Potato Council in creating a new potato manual for the Prairie Provinces.

Workshops, field days and grower meetings

The extension agronomist, in association with the Potato Growers of Alberta, held several breakfast meetings beginning in early spring through to end of harvest. These meetings covered a variety of topics ranging from irrigation management, IPM, early and late blight management, insect management, to any general or specific concerns. Potato growers continue to practice an aggressive late blight program and again, no late blight was found in southern Alberta. The potato grower field day was held in July. All of those in attendance visited the demonstration plots listed above.

The extension agronomist, in association with the Potato Growers of Alberta, organized and hosted the annual Western Potato Council Meeting and Conference at the Lethbridge Lodge in January 2003.

The extension agronomists, in association with several AAFRD and industry staff, put together a bacterial ring rot workshop to educate commercial field inspectors on the disease.

The extension agronomist, in association with other southern Alberta extension agronomists and scientists, sat on several organizing committees for upcoming conferences and workshops, such as, Agronomy Update (Lethbridge) and The Right Amount Conference (Taber).

Seed Potato Program

P. Duplessis McAllister and T. Lewis

The main objective of the seed potato program at CDCN is to provide support to seed potato growers throughout Alberta. This is accomplished through research trials and extension services. The program works closely with the Potato Growers of Alberta to ensure that the needs of the industry are being met.

Seed Potato Repository

The purpose of AAFRD's seed potato repository is to maintain a collection of disease-free cultivars and lines to ensure that all participants in the Alberta seed potato industry have equal access to plants for nuclear production. This is accomplished by multiplying disease-tested stock plants for private labs. In 2002, 31 public potato cultivars and accessions and 28 private cultivars were distributed to private laboratories across the Western Provinces for multiplication. Plant Breeders' Rights issues are changing the face of high generation seed potato production in North America and program staff continue to work closely with private breeders and their agents and Alberta Seed Potato Inc. to ensure that new varieties remain eligible for protected status while seed growers are increasing available seed stocks. Each year more private cultivars are added to the repository and their acreage in Alberta also continues to increase.

Research Projects

Red Norland trial

The Repository at CDCN contains several Norland lines and growers are continually asking which is the 'best'. In 2002, the third year of a replicated field trial to evaluate the lines in a side by side comparison was completed. This year Red LaSoda, NorDonna, Chieftan, IdaRose, Red Pontiac, Red Gold and Rode Star were also included in the trial. CalRed was removed from the trial in 2002 due to a food safety issue of high glycoalkaloids in California grown tubers. Harvest yield and size data were collected and tubers were ranked according to tuber type, color, splotching and overall appearance. 2002 was the second year of an early harvest component of the trial to determine if any of the lines were better suited to early harvest conditions. Data analysis is ongoing and final results will determine if the trial is continued in 2003.

Giberellic acid seed treatment on Shepody and Russet Burbank

Giberellic Acid was shown to increase stem number and decrease average tuber size without reducing yield in trials conducted in 1998 and 1999 at CDCN. In 2002, Shepody and Russet Burbank tubers were treated with 10 ppm GA3 to examine the effect of GA and plant spacing on tuber profile and yield. The trial will be repeated in 2003 because of wide variations in emergence date and plant stand. To date there is no registered source of GA available for use on potatoes in Canada and the seed program will continue to research GA benefits and potential sources.

Red skin color Trial

The objective of this study was to determine the color retention of several of the red varieties in the CDCN Seed Pototo Repository and to determine the effect of foliar 2,4-D application on skin color. The trial was initiated in 2001 and continued in 2002. Residue analysis of 2,4-D treatments has not been completed at this time. Data are still under review. Due to a lack of funding work on red skin color will be discontinued until a source of funding can be secured.

Variety demonstration trial

Potato varieties and selections maintained in the repository are grown in the greenhouse on an annual basis to ensure that the lines have remained pure and productive. Nuclear tubers produced at this facility are planted in the field for assessment of 'trueness to type'. Evaluation of potato cultivars is necessary to ensure that the seed potato industry is provided with a high quality seed source. This past year, the plot included 93 cultivars.

Growers visited the plot during the Regional Trial tour and took the opportunity to look at the many cultivars that are in the repository. Visitors from Mexico were interested in the trial as were representatives from private companies looking at niche market varieties.

Prairie regional trials - early and main crop replicated trials

These trials are conducted annually in cooperation with AAFC - Lethbridge. They are an integral part of the AAFC Potato Breeding Program. New cultivars and accessions are compared with well-known standards to assess performance, maturity, yield and specific gravity. The observations are used to select new potato cultivars for the prairies.

CDCN was an early and a main crop trial site in 2002 and was also an irrigated demonstration trial site for 15 advanced selections and 8 industry standards. The early crop trial included 8 breeding lines and Atlantic, Norland, Russet Norkotah and AC Ptarmigan as standards. The main crop trial included 16 breeding selections and 2 Colorado Norkotah Russet strains for evaluation. Russet Burbank, Ranger Russet (Amisk), Russet Norkotah, Shepody, Atlantic, Norvalley, Norland, Sangre and Snowden served as standards. Growers had the opportunity to tour the site on August 22 in conjunction with a PGA grower meeting and Dr. Dermot Lynch of AAFC - Lethbridge was on hand to answer questions about the advanced selections.

Technology Transfer

The seed potato specialist, P. Duplessis McAllister, provided extension services to growers and industry personnel through direct contact and presentations at meetings and conferences. She also acted as a liaison with the Canadian Food Inspection Agency.

In 2002, the seed potato program cooperated with the PGA to organize winter test sample collection and dormancy breaking as well as GMO seed lot testing for spring 2003.

The seed potato specialist and technologist worked closely with new and interested lab, greenhouse and seed producers to help ensure that they had adequate information and resources.

Organized the following seminars/workshpos:
CDCN Potato Field Day and Grower Tour
Participated in meetings and conferences:
Washington State Potato Conference and Trade show, Moses Lake, WA
PGA Annual Meeting, Red Deer, AB

Soil and Water Agronomy Program

S.A. Woods and L. Hingley

Research Projects

The soil and water agronomy program conducts research on water, fertilizer and sustainable soil quality requirements of special crops, horticultural crops and irrigated forages. Some research projects were done cooperatively with staff from other programs at CDCS and other divisions of AAFRD. Soil samples were analysed by AAFRD's Soil and Crop Diagnostic Centre, Edmonton.

Site specific management of potatoes

Potato crops have many characteristics that make them suitable for precision agriculture, such as a high value with costly inputs of pesticides, fertilizer and water. The application of fertilizer and pesticides on potatoes may cause environmental problems; the risks of these can be reduced by using precision farming techniques. In response to these conditions, a project on the site specific management (precision farming) of potatoes began in 1996 and the field research concluded in 2001.

A poster presentation of the results was given at the Alberta Soil Science Workshop. The final report was completed in 2002 and submitted to AARI, posthumously, on behalf of Dr. Colin McKenzie, project manager. The objectives were to measure and map yield variability within a field; to determine the effects of soil type, landscape position, soil fertility, diseases and weeds on potato yield; to determine the variability in yield of preceding crops, and to relate this to field variability and tuber production; to measure the cost benefits and environmental influences of site-specific management; and to evaluate the use of remote sensing and digital image analysis of fields to detect nutrient deficiencies and diseases of potatoes.

Precision fertilizer application is practiced on some potato farms in Canada, but the use of this technology is limited by the cost of soil sampling and analysis to accurately describe the field. If precision agriculture technology is to achieve widespread adoption in the potato industry, solutions to the obstacles of cost, soil clods and other issues need to be incorporated into the technology.

Three-year phosphorus release rates from composted manure

Follow-up soil samples were taken, in 2002, from a three-year study (1999-2001) of compost as a fertilizer phosphorus source. The objective was to determine the three-year nutrient release rates to plant-available form (inorganic) from composted cattle manure. Soil samples were collected from three fields involved in potato rotations. One of the fields had received rates of compost in 1999, one in 2000 and one in 2001. Results indicated that one-, two- and three-year average annual nutrient release rates, in the 0-

15 cm depth range, were 5, 1 and 2% for nitrate nitrogen; 3, 15 and 25% for phosphate phosphorus; and 17, 39 and 26% for potassium, respectively. Overall, nutrient release rates showed a decline with increasing compost application rates. Nutrient release rates were lower and later than expected, likely due to the colder climate and shorter growing season found in southern Alberta. No changes in organic matter were observable with these single applications of compost. The high degree of variability in soil characteristics (texture, moisture and fertility), combined with the high degree of variability in application rate of compost across a field, make studying the field-scale nutrient release rates of compost difficult.

Long term viability and salinity tolerance of dryland forage and turf grasses

A field experiment, to determine the salinity tolerance of 20 species of forage and turf grasses, was established in 1991 on a farmer's field, near Oyen, AB. In June of the following year, plant samples and salinity readings were collected from four of the species, to determine the yield response to changes in soil salinity. The remaining species were unable to establish due to drought conditions, so the plot was abandoned.

In the spring of 2002, the soil and water agronomy program was notified that the plot was still in existence and that some of the species that had remained dormant in 1991-1992 had now established. Plans to collect plant samples in the late summer of 2002 were prevented by a grasshopper infestation, which consumed the bulk of the plants' forage material. Instead, counts of healthy plant clusters were taken in September. Superior drought and salinity tolerance were exhibited by the species that germinated and survived in sufficient quantities to be sampled in 1992 and 2002. All of the species sampled in 2002 are purported to have high or very high persistence over time, with the exception of Arthur Dahurian wildrye, which is purported to have low persistence. Yet, it continued to produce after 11 years in the field. Overall, the Dahurian and Russian wildryes showed the greatest tolerance to soil salinity in 2002. It is recommended that forage samples be collected, if possible, for a more accurate assessment of long-term plant vigor and response to soil salinity.

Mapping of Crop Diversification Centre South

Salinity, topography and plot maps were made for Lendrum Farm and portions of MacLeod Farm, using the GPS and EM38 equipment. During the 2002, season, access to fields was limited due to moisture conditions and plot locations. Plans are in place, for 2003, to complete the mapping at MacLeod Farm and begin mapping of the Bow Island sub-station. Soil salinity maps had been made in 1989, from grid-sampled core data, for the Bow Island site. These maps were refined and provided to CDCS management in 2002, to aid in situating research plots there.

Field scale spatial and temporal variability of nitrous oxide gas emissions (with five nitrogen fertilizer application rates)

This project was part of a Canada-wide study and began in 2000 in collaboration with the U of S. The majority of field measurements were taken in the 2001 growing season. Final field data collection was completed early (prior to planting) in 2002. Data was assembled and sent to the project manager. Ongoing support was provided throughout 2002, through report preparation, poster presentation at the Alberta Soil Science Workshop and explanation of field data.

Agriculture is considered to be a major source of nitrous oxide (N_2O) and other greenhouse gas emissions. Proper management practices are required to minimize gas emissions from agricultural fields. However, there is a limited understanding of the factors controlling the spatial and temporal variability of N_2O flux at field scale. The objective of this study was to quantify the field scale spatial and temporal probability distributions of N_2O and carbon dioxide (CO_2) fluxes under varying nitrogen (N) fertilizer application rates. A field site (near Hays, AB) with significant prior information available on the spatial variability of soil properties and crop yield response was selected to measure field scale N_2O and CO_2 gas fluxes, from five N fertilizer rates (9, 40, 80, 120 and 160 kg ha^{-1}), across the major areas of variability in the field.

Significant increases in N_2O gas flux occurred for N fertilizer rates in excess of the soil N_2O test recommended rate of fertilizer. The average N_2O flux and spatial variability of N_2O flux increased as N application rate increased, especially greater than 80 kg N ha^{-1}, the recommended rate. Grain yields only increased up to 80 kg N ha^{-1}. No relationship between average CO_2 flux and N rate was found. Both N_2O and CO_2 fluxes increased with time, particularly after day 27 (May 22). There was spatial variability in N_2O and CO fluxes, but these were not related to clay content of soil.

Phosphorus and compost on irrigated potato crops

In 2002, the final results for this three-year (1999-2001) project were collected and analyzed and a report prepared and presented at the Alberta Soil Science Workshop.

Alberta's intensive livestock operations produce large amounts of manure. When managed appropriately, manure is a natural fertilizer source, which can provide macro and micronutrients as well as organic matter to the soil. Recently, feedlot manure has been composted in order to kill weed seeds and to remove water, thereby concentrating nutrients, decreasing shipping costs and creating a value-added product. Between 1999 and 2001, field-scale research was conducted into the effectiveness of various rates of composted manure, as a spring applied phosphorus (P) source for irrigated potatoes, as compared to various rates of mineral P fertilizer. Phosphorus fertilizer and compost treatments were surface applied on strips within irrigated potato crops. Total plot sizes ranged from 12 to 23 acres, with 8 to 11 treatments. Each year, on each field, petiole (plant tissue) samples were collected at three dates. Potato samples were gathered and the tubers were graded by size and assessed for specific gravity and disease. Increased inputs of P gave increased levels of petiole P for both mineral fertilizer and compost, yet, there were no consistent effects on yield. These results indicated that some of the P in the compost was immediately plant-available, even in early July. Despite increases in petiole P, there were no discernible effects on yield, calling into question current fertilizer and petiole P recommendations. Compost had no negative impacts on plant or tuber disease and was associated with a lower incidence of *Rhizoctonia* at Fincastle in 2000. Compost had a small effect on specific gravity values, in some instances decreasing it slightly. Compost was a good source of P and K. When combined with mineral nitrogen fertilizer, it has potential for improving potato yields.

Effects of topography and soil horizonation/layering on long-term solute transport under semiarid conditions

This project is the soil and water agronomy program leader's PhD. thesis research, which was part of the program's succession plan. In 2002, data analysis continued, an oral presentation was made at the Alberta Soil Science Workshop and a poster given at the Canadian Society of Soil Science annual meeting.

Understanding of solute transport through the vadose zone in semi-arid environments (e.g., Canadian Prairie) is limited. The objective of this study is to quantify the influence of topography and soil horizonation on the spatial variability of water and solute transport after 34 years under transient, unsaturated, semi-arid conditions. In 1966, a chloride tracer (as KCl) was applied to plots (8m x 90m, Chernozemic soil) near Saskatoon, SK. In 2000, a total of 202 soil cores (6m depth) were taken from a transect, across one of the plots. The soil horizonation/layering of each core were recorded. Each core was sectioned (0.1m intervals) and samples (N>12000) were analysed for chloride concentration, bulk density and soil water content. Historic sampling indicates that the chloride center of mass was at a depth of approximately 1m after 4 years. After 34 years, the chloride center of mass is at approximately 2.6m in slight convex areas, compared to 1.3 – 1.6m in level areas. There is significantly faster transport in depressional areas, which is attributed to snow/snowmelt re-distribution. The influences of subtle changes in surface topography and soil horizonation/layering on the average depth and spread (vertical and lateral) of the chloride tracer is being studied.

Technology Transfer

Soil and water information was provided to a diverse audience through papers, posters and presentations. Presentations were made at technical conferences and producer meetings; inquiries were answered through telephone contacts, office visits and correspondence.

At the 39th annual Alberta Soil Science Workshop in Nisku, three posters and an oral presentation were given. A poster presentation was made at the Canadian Soil Science Society meeting in Banff.

A chapter on the precision farming of potatoes was completed for a textbook titled "Precision Farming – A Global Perspective". The final report (92 pages) was prepared for the site specific management of potatoes project and submitted to the AARI.

Information on methods of soil salinity measurement and crop tolerances to salinity were provided to various groups, including a course for industry agronomists in Taber, a presentation to a Sask-Water tour group, a class lecture at the University of Lethbridge (Geography 4760: Agricultural Soil Management) and discussions with visitors from Australia and Iran.

Special Crops Program - Brooks

M. Bandara. C. Weisbach, A. Fox, J. Webber and E. Russell

The special crops program at CDCS is primarily responsible for the evaluation, introduction and development of alternative or new crops for southern Alberta through applied and adaptive research. Some study projects are conducted in collaboration with other research programs at CDCS, other divisions of AAFRD, University of Alberta, University of Saskatchewan, AAFC, Applied Research Associations and industry partners. Different funding sources such as Farming for the Future Matching and Direct Funding Grants, regional and cooperative varietal testing programs and also several industry partners provide the financial support for the program.

Research Projects

Chickpea and lentil crop improvement program

In 2001, a five-year crop improvement program for chickpea and lentil was initiated at the CDCS in collaboration with the Crop Development Centre, U of S, Saskatoon, SK, where new crosses of both crop species are performed. The main objective of this project is to develop new chickpea and lentil cultivars for southern Alberta under dryland conditions with specific selection criteria of high seed yield, early flowering early and uniform maturity, resistance to common foliar and root diseases and desired market traits. Each year, 500 pre-selected F_3 lines from each crop species are grown in micro-plots at the Bow Island substation and two test sites in F_4. Promising lines will be selected in F_5 and subsequent generations in multi-location trials in southern Alberta. Superior lines will be released as varieties to Prairie pulse growers.

In 2001, the lentil plots experienced a fairly strong disease pressure combined with drought causing complete loss of some of the new lines. Nevertheless crop establishment was satisfactory. In 2002, the crops were exposed to excessive soil moisture conditions, frequent cold period and severe weed pressure (The June precipitation was 159.0 mm, more than twice the normal of 69.6 mm). Excessive available soil moisture encouraged the indeterminate growth habit, particularly in chickpeas. Despite the adverse growing conditions in southern Alberta, the ascochyta leaf blight incidence was very low at the test site, and line selection for desired crop and seed characteristics was performed.

Fall vs. spring seeding of desi chickpea

Fall seeding, or dormant seeding, refers to the planting of spring crop species in the fall, prior to freeze up. A field study was conducted in 2001/2002 cropping season at CDCS using the desi chickpea cultivar Myles. Treatments included two seeding dates in late fall (Oct. 23 and Nov. 2, 2001) and one seeding date in early spring (May 02, 2002) with different seeding rates for each fall seeding treatment (1 time, 2 times and 4 times the recommended seeding rates for uncoated seed and the recommended seeding rate for plastic polymer-coated seed - Grow Tec Inc. Edmonton, AB) and the recommended seeding rate for the early spring seeding treatment. The crop was grown under dryland conditions. Data collection included stand establishment at 5 weeks after spring seeding, date of first flowering, date of maturity, plant height at harvest, 1000-seed weight, number of seeds per plant at harvest, harvest index and plot seed yield after eliminating borders.

On average, the fall-seeded chickpea crop was shorter than the spring-seeded crop. Increasing seeding rate increased plant population density in both fall-seeded treatments. The plant population density of the fall-seeded polymer-coated treatment was only 57% of the actually seeded density (55 seeds per m^2), similar to that of the other fall-seeded treatments with the recommended seeding rate. This indicates that the polymer seed coat treatment had no beneficial effect on seedling establishment of fall-seeded desi chickpea. Plants from the fall-seeded treatments flowered and attained maturity 10 days and 7 days, respectively earlier than spring–seeded over all seeding dates and rates.

In summary, results indicate late fall seeding of desi chickpea can be practiced in southern Alberta. The early and uniform crop maturity from fall seeding is critical in years with above normal precipitation in August. Since our conclusions are based on result of one season single-site study, comprehensive studies covering a wide range of soil and climatic conditions in the Brown and Dark Brown soil zones, are required before fall seeding can be recommended in southern Alberta.

Fall- seeded spice crops

Fall seeding of small-seeded spring crops such as canola is becoming popular among growers in the Prairies because of improvement in crop quality and yield compared to that of spring-seeded crops. Using the canola seeding model, fall seeding studies were established at CDCS with four spice crop species, anise, coriander, dill and mustard. Different seeding rates (1 time, 2 times and 4 times the recommended rate) of uncoated seed and polymer-coated seed at 1 time the recommended rate were used as treatments. Crop growth performances and seed yield of the fall-seeded crops were compared with those of spring-seeded crops.

Anise (*Pimpinella anisum*)

On average, fall-seeded anise crop was shorter than the spring-seeded crop. Increasing seeding rate consistently increased plant population density of the fall-seeded crop, but had no significant impact on fruit yield. Polymer-coated seed treatment improved the stand establishment, particularly in the early November-seeded treatment. On average, fall-seeded crop matured three week earlier than the spring seeded-crop.

Coriander (*Coriadrum sativum*)

Increasing seeding rate of the fall-seeded uncoated treatment significantly increased the plant density and fruit yield, but had no impact on the final plant height or crop maturity. The polymer-coated treatment had no significant effect on over-wintering ability of coriander. The seeding date during the late fall had no significant impact on plant density or fruit yield in coriander indicating that the crop can be seeded with a wide window in the fall without having a significant impact on the crop stand. In summary, results indicate that dormant seeding of coriander can be practiced in southern Alberta and seeding rate should be increased to 2 times the recommended seeding rate to obtain a satisfactory crop stand.

Dill (*Anethum graveolens*)

In general, seeding rate of the uncoated fall-seeded treatment had no significant impact on final plant height or crop maturity of dill. However, seeding rate consistently increased fruit yield by improving stand establishment. The polymer-coated treatment had no significant impact on either plant density or fruit yield. In summary, these results indicate that dormant seeding of dill can be practiced in southern Albert, but seeding rate should be increased to 2 times the recommended seeding rate to obtain a satisfactory crop stand.

Yellow mustard (*Sinapis alba*)

In general, the crop of the uncoated fall-seeded treatment produced taller plants when grown at higher seeding rates compared to those grown at lower seeding rate. On average, the spring-seeded crop was significantly taller than the fall-seeded crop. Irrespective of date of seeding, increasing seeding rate of the fall-seeded crop consistently increased the seed yield. On average, the seed coat treatment produced significantly higher (over 52%) seed yield than the corresponding uncoated treatment. These results indicate that dormant seeding of mustard can be practiced successfully in southern Alberta. When using uncoated seed for fall seeding practice, the seeding rate should be increased to 2 times the recommended seeding rate to obtain a satisfactory crop stand. The fall-seeded crop matured about one month earlier than the spring-seeded crop, thus early crop maturity would be considered the main beneficial impact of this practice.

Impact of size of the seed planted on crop phenology and seed yield

The size of the seed planted has been shown to have a significant impact on seedling establishment, seedling vigor and crop growth of several small-seeded field crops such as jute, mustard, coriander and carrot. In contrast, other studies have revealed that size of the seed had no significant impact on plant growth and development, and the final seed yield of large-seeded crops such as chickpeas. Two studies were conducted at CDCS to examine the effect of size of seeds planted on seedling growth, seed yield and seed size profile of the resulting crop of four kabuli chickpea cultivars and four pinto bean cultivars under field conditions in southern Alberta.

Kabuli chickpeas

Three large-seeded kabuli chickpea cultivars, Sanford, Evans and CDC Xena, and one small-seeded kabuli cultivar, CDC Chico were used for this study. Seeds of each chickpea cultivar were screened into two size categories and size of the screens used was cultivar-dependant (For example large-seeded cultivars, <8.7 mm and >8.7mm and for small-seeded cultivar, < 8.1, and > 8.1 mm). The crop was grown dryland conditions. Data collection included stand establishment at 5 weeks after seeding, date of first flowering, plant height at first flowering, date of maturity, number of seeds per plant at harvest, 1000-seed weight, harvest index, plot seed yield after eliminating borders.

The chickpea cultivars differed in plant height, seed yield components, seed yield and seed size distribution, but the size of the seed planted had no significant impact on most of the parameters measured. The large-seeded chickpea cultivars, Sanford and Evans were taller than CDC Xena (large-seeded cultivar) and CDC Chico (small-seeded cultivar). All three large-seeded cultivars flowered simultaneously, but 5 days later than CDC Chico and the same three cultivars matured simultaneously, but 3 days later than CDC Chico. All three large-seeded chickpea cultivars produced fewer seeds per plant compared to CDC Chico. Among chickpea cultivars, only Sanford plants generated from larger seed treatment produced significantly heavier seeds compared to that of the smaller seed treatment. CDC Chico produced highest dense seed, the seed yield and harvest index among the chickpea cultivars. These observations suggest that among the yield components, the number of seeds per plant is the main yield component contributing to the high seed yield of CDC Chico. Despite the phenological differences, the lack of a significant impact of size of the seed planted, on plant growth, seed yield components and seed yield suggests that smaller seed sizes of kabuli chickpea can be used for planting without affecting seed yield or the seed size profile of the resulting

crop. This assumes that the reduction in seed size not due to disease infected seed or immature seed. A germination test should be done, if smaller seed category is used for planting purpose, the grower could reduce their seed cost due to reduced seeding rate and transportation cost. At the same time, the larger-seeded portion of the crop can be sold at a premium for human consumption purpose.

Pinto bean

Seeds of four pinto bean cultivars (Othello, Fargo, CDC Pintium and CDC Pinnacle) were screened into four size categories (<7.1 mm, 7.1-7.9 mm, 7.9-8.7 mm and > 8.7 mm in diameter). The crop was seeded at a spacing of 0.18 m between rows (narrow- row seeding) on May 25, 2002 and was grown under irrigation using recommended cultural practices. Plant population density at five weeks after seeding, plant height at harvest, 1000-seed weight, test weight, plot seed yield and seed size distribution of the resulting crop were determined.

Results indicated that pinto bean cultivars differed in plant height, mean seed weight, seed density, number of seeds plant and seed yield. On average, CDC Pintium produced the tallest plants while Fargo produced the shortest plants. Regardless of cultivar or size of the seed planted, all the bean cultivars flowered on July 16, 2002. There was a difference in crop maturity among cultivars, but size of seed planted had no impact on crop maturity. Among bean cultivars, CDC Pintium matured 105 days after seeding (earliest) whereas CDC Pinnacle matured 118 days after seeding (latest). Both Othello and Fargo matured 112 days after seeding. On average, CDC Pinnacle produced the heaviest seed (318 mg/seed) whereas Othello produced the lightest seed (297 mg/seed). On average, the size of seed planted had a significant impact on seed yield of the resulting crop, but had no impact on final plant height, test weight, mean seed weight, plant population density or number of seeds per plant. Seed yield of CDC Pintium, Othello, and Fargo plants raised from larger seed categories (> 7.1 mm) produced significantly higher seed yield than that of the smallest seed category (< 7.1 mm). However, increasing seed size from 7.1 mm to 8.7 mm had no significant impact on seed yield. For CDC Pinnacle, size of the seed planted, had no significant impact on seed yield of the resulting crop except for the largest seed category (>8.7 mm). These results indicate that medium size seed (>7.1-7.9 mm) can be used for seed purpose without having any adverse impact on seed yield, while larger seed categories can be used for human consumption purpose. The seed size profile of the resulting crop, however, was significantly different among cultivars. On average, Othello, Fargo, CDC Pintium and CDC Pinnacle produced seed lots with 45.9%, 54.1 %, 56.7 and 68.8 % in the >7.9 mm in diameter category, respectively.

Impact of growing condition on plant growth and medicinal quality of rosemary

Rosemary *(Rosmarinus officinalis* L.), a member of the *Labiatae* or mint family, is a slow growing, cold sensitive, woody perennial cultivated for the aromatic foliage. Rosemary is used primarily as a culinary herb with meats, vegetables and soups. In traditional medicine, the plant is used as an astringent and diuretic and to increase menstrual flow. Interest has been directed at using rosemary extracts as anti-oxidants in commercial food preparations. This study was conducted to evaluate the possibilities of growing rosemary as an annual crop under field conditions at CDCS and to compare the productivity and product quality of the crop with those grown under different growing conditions in controlled environments. This study included ten cultivars of rosemary, namely Apr, Blue Boy, Benenden Blue, Golden Rain, Majorca, Pink, Santa Barbara, Severn Sea, Standard and Rex. The rooted stem cuttings were transplanted in early May in the field at a spacing of 90 cm x 20 cm. The crop was grown under irrigation and harvested in late September. In the controlled environment study, the rooted stem cuttings of all ten cultivars of rosemary were grown in 3 different growing conditions (day/night: 12h/12h at 24°C/12°C, 12h/12h at 24°C/6°C and 16h/8h at 24°C/6°C) for eight months. The plants were grown in 1 L pots. Seven plants from each cultivar were included in each growth chamber. Data collections included were aboveground biomass production (fresh and dry weights), leaf dry weight/plant, total phenolic activity (TPA

=carnosic acid, carnosol and 12-methoxy carsonic acid content, expressed as a percentage of the total extract) and carnosic acid (CA) / carnosic acid (CA) +carnosol (C) ratio. All the extractions were performed at the Norac Technologies Inc., Edmonton, AB using the super-critical fluid extraction method.

Growth and product quality of rosemary under different growing conditions were cultivar-specific. Under short-day conditions (12h), night temperature (6°C vs. 12°C) had no impact on productivity or product quality of Standard, Arp, Pink, Benenden Blue and Severn Sea. Under the same short-day conditions, lower night temperature conditions (6°C) improved productivity and product quality of Majorca, Rex, Santa Barbara, Golden Rain and Blue Boy. Conversely, long-day conditions (16 h) improved both productivity and product quality of rosemary cultivars Standard, Majorca, Rex, Arp, Pink, Benenden Blue and Severn Seas, compared to short-day conditions (12 h).

Under field conditions, rosemary cultivars produced above ground biomass ranging from 116.5 to 242.0 DW g/ plant, which was 6 to 18 times higher than that of rosemary cultivars grown under controlled environments. These results suggest that rosemary can be successfully grown under field conditions in southern Alberta, as an annual crop. Under field conditions, rosemary cultivar Pink produced the highest above ground biomass (242 g DW/plant) whereas Arp produced the lowest (116.5 g/plant). Rosemary cultivars Pink, Rex, Blue Boy and Severn Sea were the highest biomass producers (> 190.0 g/plant), followed by Santa Barbara, Standard and Benenden Blue (> 135.0 g/ plant), and Majorca, Golden Rain and Arp (> 116.0 g/plant). The total phenolic activity (TPA) and ratio of carnosic acid/carnosic acid+carnosol are considered quality parameters of the rosemary extract. The rosemary culitvar Standard produced the highest TPA (5.96 %), followed by Pink (5.65%), Blue Boy (5.63%) and Arp (5.17%) and the cultivar Severn Sea contained the lowers TPA (4.14%). Severn Sea contained the highest CA/(CA+C) ratio (98.1%), whereas Golden Rain contained the lowest ratio (94.8%). The imported rosemary generally contains TPA within a range of 2.5- 3.0% and the minimum CA/(CA+C) ratio should be > 75%. Since these quality standards are much higher than those of imported rosemary, it can be concluded that the Alberta-grown rosemary are higher in quality compared to the imported rosemary.

Crop selection and improvement

Seed of *Echinacea angustifolia*, *E. pallida*, *E purpurea* and borage and stolons of peppermint, spearmint and Alaskan mint were treated with mutagenic compound, Ethyl Methanesulphonate (EMS). Treated seeds and stolons were planted in plugs or pots and placed in a greenhouse. In early spring of 2000, both Echinacea and mint species were transplanted in the field at CDCS. Echinacea species are being evaluated for aster yellows disease resistance and medicinal quality whereas mint species for over wintering ability and essential oil contents. Foliage of individual mint plants raised from the treated stolons was used to extract essential oil and crop selection based on essential oil content, oil composition and over-wintering ability is in progress.

The seed harvested from borage plants raised from the EMS-treated seed were planted in spring 2002 in the field for selection and seed multiplication. Based on maturity, borage plants were categorized into several groups and further selection is in progress based on seed shattering, and seed oil content and quality.

Regional/ Co-op Trials

Newly developed breeding lines and promising cultivars of chickpeas, drybeans, fieldpeas, fenugreek and fababean received from various crop breeding programs are evaluated under dry land and irrigated conditions in southern Alberta, to select suitable cultivars for the region.

Drybean cultivar/line evaluations

The emphasis in the drybean cultivar testing in southern Alberta is on yield performance, early maturity and architecture of a drybean plant that allows for narrow row configurations, direct combining and consequently an expansion of the present

drybean production area. Breeding programs at the AARC - Lethbridge and the Crop Development Centre at the U of S are developing promising lines of this type of drybean. Information generated from these studies will be used for further evaluation, cultivar registration and recommendation purposes.

Four yield tests (two coop and two regional tests) with various drybean lines/ varieties were established on May 31, 2002, at the Bow Island sub station under irrigated conditions. All the dry bean tests at the Bow Island site were abandoned due to poor seedling emergence caused by excessive rainfall received in mid June of 2002.

Field pea cultivar/line evaluations

Three fieldpeas cultivar trials were conducted at CDCS (dry land and irrigated) and Bow Island (dry land) to evaluate varieties/lines for screening and regional adaptation. Only two test sites (CDCS-irrigated and Bow island) were harvested. The dry land test at CDCS was abandoned due to severe crop damage caused by the Sencor (Metribuzin) application.

Other special crop cultivar evaluations

Different lines and registered varieties of other pulse crops such as chickpea, faba bean and soybean, were evaluated for regional adaptation. Three kabuli and three desi type chickpea regional tests were established under dry land conditions at Bow Island, Brooks (CDCS) and Carmangay. The trials at Bow Island and Carmangay were harvested, but crop yields at the Bow Island test site were very low (333–1391 kg/ha) due to excessive secondary crop growth combined with later crop maturity caused by excessive soil moisture conditions. Crop yields at the Carmangay site, however, were satisfactory (893-3788 kg/ha). The test site at Brooks was abandoned due severe crop damage by the Sencor application. Several cultivars/lines of silage and grain corn, soybean and faba bean were established for regional adaptation. Both silage and grain corn performed very well under both Bow Island and Brooks growing conditions. The soybean and faba bean tests were abandoned due to poor seedling emergence caused by excessive soil moisture conditions at the Bow Island site.

Technology Transfer

Program staff continued to answer numerous inquiries on the production of special crops, particularly on herb, spice and essential oil crops. Information was contributed on special crops to producer newsletters and the news media. Program staff participated in courses, seminars, conferences and field tours. Demonstration plots of various special crops, including pulse crops, herbs, spices, essential oil, medicinal plants and other new crops at Brooks and Bow Island were visited by a large number of interested individuals and groups. Extension staff and other interested parties were provided with planting materials for demonstration and field testing to assist herb, essential oil and spice producers evaluate new crops and to develop agronomic practices.

Special Crops Program - Edmonton

K. Ampong-Nyarko, S. F. Blade, N. Clarke, J. Teulie, C. Jiao and R. Bok-Vischer

The special crops program at CDCN has been active in the identification and development of promising economic crops since 1995. The focus has been research on several categories of new crops: pulse; medicinal, culinary and aromatic herb; and non-food industrial crops.

Research Projects

Pulse Crops

Western field pea co-operative trial

In 2002, Western Field Pea Co-operative Trial, Cutlass field pea, (released last year by Stan Blade) did well. It out-yielded the checks in both northern and southern Saskatchewan trials by 19%.

Field pea breeding and germplasm evaluation CDC Advance

To jumpstart the field pea breeding program, CDCN staff have established a strong collaboration with the Crop Development Centre in Saskatoon to obtain early-generation lines from crosses targeted to the cool, moist conditions of Alberta.

The original non-replicated screening in 1996 was followed by a replicated preliminary yield trial in Edmonton and Grande Prairie in 1997. Elite material was put into an ongoing yield test in several locations in Saskatchewan and Alberta. In 2002, 1000 F3s were planted in Edmonton and Namao. Their performance was observed under the extremely dry conditions that prevailed.

AAFRD/AAFC Breeding Agreement -

In 1997 an agreement was signed between CDCN and the AAFC - Morden, MB Field Pea Breeding Program. Approximately 200 lines were tested in 2000; the best lines were evaluated in 2002.

CDCN - Pea lines crossed in the greenhouse were planted in the field for the 2002 growing season. These new materials were evaluated with several objectives in mind: plant maturity, height, harvestability, plant architecture, disease resistance, seed vigor, and yield.

Narrow leafed lupins (*Lupinus angustifolius)* yield and yield parameters

One specific outcome of the collaboration that Stan Blade developed with European researchers at the 4th European Grain Legume Research Network in Cracow last year was the initiation of research into lupins in 2002. Lupins are very high in protein (32-40%) and energy levels (due to 6-7% oil). Preliminary trials in 2002 indicated some promise using genetics from northern Europe, rather than Australian cultivars, which have failed in earlier provincial tests. Lupins could be a viable alternative to soy imports; additional work needs to be done to make a realistic assessment of lupin potential.

Yield potential and constraints analysis of field pea crops

This trial was originally set up in 1998 as the Intensive Pea Management Trial to evaluate the impact of four major management practices in the production of field pea across Alberta. Results indicate that seeding rate and fungicide application date were the two important variables affecting this study. This led to a shift in focus for the 2002 season, concentrating on issues that have a direct affect on the growers: improve use efficiency of crop production inputs.

In 2002, on station experiments were conducted at CDCN and CDCS to establish potential dry pea yields. The experiment was 2x 2x3 factorial combination of density (75 plants/m^2, 150 plants/m^2), water (irrigation, rain fed), fertilizer (inoculants only, inoculants + 50 kg N/ha, 65kg N/ha).

There was general lack of response of pea to input under rain fed conditions. Experimental comparisons of farming technologies such as high plant density, extra nitrogen had only small impact on yield.

Irrigation accounted for most of the yield variation. The average irrigation yield of 5096 kg /ha was double that of rain fed (2504 kg/ha). Pea is described as a low input crop, and relatively unresponsive to fertilizers, particularly nitrogen. It is therefore reasonable that drought related research should be given priority in order to raise Alberta pea yields, improve efficiency, competitiveness, and profits.

Drought research

A project that will allow Alberta farmers to proactively manage drought using a value-added product (glycinebetaine) from sugarbeet refinery was initiated in August 2002. Glycinebetaine is foliar applied at rates of 2 kg/ha and is currently being evaluated under greenhouse conditions. In a preliminary observation, positive response was observed for tomatoes and canola. The project is being funded under the IDS New Initiative's Fund.

Medicinal Herb Research

Echinacea was selected as one of several crops that Alberta has an advantage to grow and market.

Echinacea field production system trials

Studies were initiated to answer growers' questions on plant density, spacing, time of planting and winter survival. Six plant densities of *Echinacea angustifolia* were evaluated: 10, 20, 40, 80, 160 and 320 plants/m^2 The trial was replicated 4 times. Assessments will be carried out in 2003 growing season.

Echinacea time of planting and winter survival trial

Echinacea bare roots seedlings were field transplanted at CDCN on 6 June, 26 June, 17 July, 7 August, 28 August, 18 September, 9 October to study effects of time of planting on establishment and winter survival. Plant assessments will be carried on in the second year of establishment.

Greenhouse production of Echinacea

Greenhouse production of Echinacea can be an additional production system alongside conventional field production to reduce the length of the production cycle from three years to 10 months. The ability to adopt greenhouse production technology for the cultivation of echinacea is seen as a key step in advancing the status of this industry. Growing echinacea in the greenhouse will have several advantages: production time will be reduced dramatically; the need for weed control will be reduced; reduction of aster yellows; harvesting will be easier and can be timed to coincide with off-season of European and North American field-grown Echinacea and producers could better forecast prices and take advantage of rising world prices.

Greenhouse echinacea was established in June 2002 to determine optimum density, length to economic maturity by harvesting at different growth periods, yield, root age and size on echinacoside content in echinacea. The experiments will be harvested in March and April 2003.

Preliminary comparative agronomic evaluation of new crops

An observation plot was established to compare adaptability between different major and minor special crops (cereals and pseudocereals, grain legumes, forages, oilseeds, aromatic, spice, medicinal) and also serve as demonstration plots at CDCN. Crops grown included:

yarrow (*Achillea millefolium*),
dill (*Anethum graveolens*)
arnica (*Arnica chamissonis*)
quinoa (*Chenopodium quinoa*)
black cohosh (*Cimicifuga racemosa*)
teff (*Erogrostis tef (Zucc.)*

borage (*Borago officinalis*)
mustard (*Brassica hirta, Sinapis alba*)
safflower (*Carthamus tinctorius*)
caraway (*Carum carvi*)
buckwheat (*Fagopyrum esculentum A*)
Jerusalem artichoke (*Helianthus tuberosus*)
lathyrus (*Lathyrus sativus*)
basil (*O.basilicum).*

The crops were seeded late and were grown with supplementary irrigation to help in establishment. All crops flowered but did not reach physiological maturity before first frost. Under this preliminary observation Proso millet (*Panicum miliaceum* L.) was rated as having good potential and warrants further research. It can be used as feed grain or birdseed. Forages from proso millet are palatable, high quality feedstuff for cattle. Proso millet is especially well suited to dry climates and is a short season crop.

CDCN-Alberta New Crops Network Medicinal herbs trial

Clary sage (*Salvia sclarea*), perilla (*Perilla frutescens*), lady's mantle (*Alchemilla vulgaris*), Joe Pye weed (*Eupatorium purpureum*), wild indigo (*Baptisia tinctoria)* senega (*P. tenufolia*), maralroot (*Rhaponticum carthamoides*) were planted in collaboration with the Alberta New Crops Network The trial was discontinued because of poor germination.

Development of multi-pest economic threshold for tarnished plant bug and western flower thrips in strawberry for the Canadian prairies

The objective of North America Strawberry Growers Association sponsored project was to establish the economic thresholds for western flower thrips and tarnished plant bug in strawberry as single pests and when they occur together. Strawberry plants were grown in the greenhouse in 2-gallon pots using the day-neutral cultivar Seascape. At flowering individual plants were introduced into separate cages built of fine thrips-proof mesh. Strawberry plants were then artificially infested with target density of western flower thrips(WFT) and nymphal tarnished plant bugs (TPB).

Result indicated that the maximum thrips density of 30 thrips per plant used in the study did not cause any significant damage to the strawberries. There was also no significant effect of thrips on yield parameters including number of marketable fruits, weight of marketable fruits, and total number of fruits in both trials.

On the other hand, significant effects of tarnished plant bug were observed on strawberry fruit yield and quality. There were significant differences of TPB numbers on total fruit yield, and the number weight of unmarketable fruits. Five lygus per plant reduced strawberry yield by 60% in the first trial and 49% in the second trial. The number of berries was reduced by 31% and the weight of marketable fruits by 80%. One tarnished plant bug per plant did not cause any significant damage to strawberry. There was no significant lygus and western flower thrips interaction on any of the parameters observed. This indicates the multi-pest interactions could be additive. Individual pests in the system should each reach their individual threshold to cause an economic damage.

In a second series of experiments, also in the greenhouse the effects of WFT and TPB density on individual strawberry flowers were studied to help us refine the thresholds. Lygus damage to strawberry fruit was observed at 3 TPB per flower and above. There was no fruit development at 5 TPB per flower and over. Cat-faced fruits were evident at 3 TPB per flower. In Atlantic Canada the economic threshold for lygus is 0.5 nymphs per flower cluster that is similar to observations from this trial.

In a third greenhouse experiment, the effects of thrips density on individual strawberry flowers was studied. Thrips density as high 120 per flower could not cause flowers death and allowed berries to reach maturity. Fruit size was variable but no damage was caused to the strawberries by WFT density of up to 30 thrips per flower. This suggests that though WFT has the potential to cause economic damage it is will be rare that populations will develop to such levels required to cause economic damage in northern climates.

Biopesticide Neem: A component of integrated pest management for greenhouse and organic production in Alberta.

The objective of this project was to establish the potential of the biopesticide neem in biologically intensive pest management in greenhouse and organic horticultural crops. The results of the studies indicate that neem is as effective as insecticide in controlling whiteflies. Neem at 2-3% also gave good control of western flower thrips. The optimal application interval for neem for whiteflies was once weekly. The residual toxicity of neem to biological control agents *Encarsia formosa* and *Phytoseiulus persimilis* indicates that neem is relatively more compatible for integration into biological control than the insecticide. Neem will have several potential benefits to agriculture when it becomes commercially available in Alberta. It will be an alternative control tool for use in bio-intensive IPM available to greenhouse growers. Neem could be used to manage insects that have become resistant to synthetic pesticides. However, its most useful role will be its use in insect pest management in organic farming. This work was done in collaboration with Dr M. Mirza, Dr Ken Fry, Dr. André Bélanger and Dr. Thadée Musabyimana (AAFC - CRDH Saint Jean-sur-Richelieu) and funded by Alberta Market Gardeners Association, Alberta Horticultural Congress and PRONOTEX.

Technology Transfer

Echinacea Forum

A very successful Echinacea Forum was held on September 26 and 27 2002 at CDCN. Crop Diversification and Business and Innovation Divisions jointly organized the forum. Sixty participants of whom 44 were active echinacea growers attended. They reported a combined acreage of 20 hectares. The forum identified lack of production information, market information as the main constraints limiting the growth of the industry. The forum also discussed organic certification, botanical certification and laboratory test for active ingredient. At the end of the meeting, the Alberta Echinacea Growers Group under the umbrella of the Alberta New Crops Network was formed with the secretariat based at CDCN to champion the growth of the industry.

Meteorological Report

N.G. Seymour

CDCS operates two automated weather stations; one at CDCS, southeast of Brooks and another at the sub-station southwest of Bow Island.

Brooks CDCS

Precipitation is measured with two instruments at the Brooks station. The Tipping Bucket Rain Gauge (TBRG) very accurate in reading rainfall to 0.2 mm is not reliable for recording snowfall. The Fischer-Porter Weighing Gauge (F&P) provides an accurate reading for snowfall equivalent. During the growing season of 2002, Brooks received above average rainfall particularly in June and temperatures were near the thirty year averages. Total precipitation for the year was less than the thirty year average for Brooks but the shortfall occurred mostly in the winter months.

The final spring frost of 2002 occurred on May 23 (-2.8°C). The first autumn frost was –2.1°C on September 22, giving a total of 125 frost-free days in 2002. This is higher than the 30-year average (1951-80) of 116 frost-free days (May 21 to September 15).

Temperatures (°C)								
	Extremes		Average				Means	
	Max	MinMa	x	30 yr av	Min	30 yr av	2002	30 yr av
January	12.0	-33.1	1.7	-5.6	-13.9	-17.0	-7.8	-11.3
February	14.3	-24.1	3.7	-2.7	-10.2	-14.1	-3.3	-8.4
March	9.3	-36.0	8.0	3.7	-5.6	-7.8	-13.9	-2.1
April	21.7	-15.4	9.3	12.7	-4.6	-1.7	2.3	5.5
May	27.4	-7.0	17.1	18.9	1.7	4.2	9.4	11.6
June	33.9	4.5	22.8	23.1	9.5	8.8	16.2	16.0
July	35.5	5.0	28.1	25.7	11.6	10.9	19.8	18.3
August	30.2	3.8	23.0	25.0	9.0	9.7	16.0	17.4
September	28.4	-4.0	18.6	18.8	5.2	4.2	11.9	11.5
October	19.0	-17.9	7.6	13.6	-3.6	-1.1	2.0	6.3
November	16.8	-12.6	7.7	1.9	-5.5	-9.7	1.1	-4.0
December	13.6	-22.4	-2.7	-4.2	-11.5	-15.7	-4.4	-9.9
Average	21.8	13.3	11.8	10.9	-1.5	-2.4	4.1	4.2

Precipitation (mm)			
	2002		1971-2000
	TBRG	F&P	30 yr av.
January	n/a	4.5	14.7
February	n/a	2.2	12.2
March	n/a	12.0	19.5
April	4.2	5.0	27.9
May	6.4	10.8	4.11
June	11.6	109.0	58.8
July	23.2	21.0	41.7
August	53.4	55.0	39.3
September	51.0	57.0	39.4
October	9.4	15.8	17.0
November	n/a	7.2	14.7
December	n/a	4.4	18.9
Total	n/a	303.9	348

Bow Island (Sub-station)

The last recorded frost was –4.2°C on May 23 and the first autumn frost (-0.6°C) occurred on September 23, for a total of 122 frost-free days in 2002, three days less than the 30-year average (1951-80) growing season at Bow Island of 125 days (May 17 to September 20).

The precipitation recorded during the summer months indicates higher than average moisture for the growing season in Bow Island particularly in June. It is important to note that precipitation is only measured with a tipping Bucket Rain Gage which is unreliable during the winter months.

Temperatures (°C)								
	Extremes		Average				Means	
	Max	Min	Max	30 yr av	Min	30 yr av	2002	30 yr av
January	13.8	-27.8	0.0	-5.2	-11.3	-15.9	-5.6	-10.6
February	11.7	-26.8	3.9	-0.9	-9.6	-11.7	-2.9	-6.3
March	9.1	-35.7	-6.5	4.7	-17.6	-6.6	-12.1	-0.9
April	19.2	-16.1	8.5	12.5	-3.9	0.2	2.3	6.6
May	27.3	-6.4	16.1	19.2	2.4	5.5	9.3	12.4
June	34.3	4.9	21.8	24.4	10.5	10.7	16.1	17.6
July	35.3	6.9	27.7	27.6	13.0	12.1	20.4	19.7
August	29.6	5.4	21.7	27.1	9.1	11.9	15.4	19.6
September	29.7	-.06	18.2	20.2	5.9	5.6	12.1	12.9
October	18.7	-21.0	8.1	15.0	-3.1	0.5	2.5	7.6
November	17.7	-11.2	8.1	4.7	-3.6	-6.6	2.2	-1.0
December	13.3	-19.3	3.7	-2.8	-9.3	-13.0	-2.8	-7.9
Average	21.6	-12.3	10.9	12.2	-1.5	-0.0	4.7	5.8

Precipitation (mm)		
	2002	1971-2000
	TBRG	30 yr av.
January	3.3	18.6
February	1.5	11.3
March	4.1	13.1
April	10.7	34.2
May	41.9	44.9
June	159.5	69.8
July	18.3	30.9
August	42.6	32.4
September	53.3	30.4
October	10.9	12.3
November	10.7	12.8
December	1.8	19.0
Average	358.6	330

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Glossary

AAFC	Agriculture and Agri-Food Canada
AAFRD	Alberta Agriculture, Food and Rural Development
AARI	Alberta Agriculture Research Institute
AMGAAlberta	Market Gardeners Association
ARC	Alberta Research Council, Vegreville, AB
CDCN	Crop Diversification Centre North, Edmonton, AB
CDCS	Crop Diversification Centre South, Brooks, AB
GPS	Global Positioning System
MII	Matching Investment Initiative
U of A	University of Alberta
U of S	University of Saskatchewan